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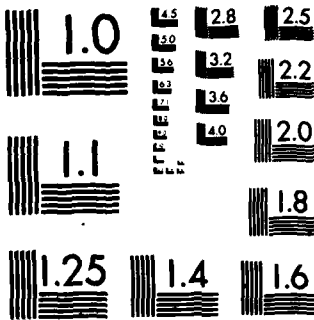
PULSED POWER BIBLIOGRAPHY VOLUME 2 ANNOTATED  
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## PULSED POWER BIBLIOGRAPHY

Volume II of II  
Annotated Bibliography

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August 1983

Final Report

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AIR FORCE WEAPONS LABORATORY  
Air Force Systems Command  
Kirtland Air Force Base, NM 87117

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This report has been reviewed and is approved for publication.

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Pulsed Power Bibliography Volume II of II Annotated Bibliography

Air Force Weapons Laboratory  
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Aug 83

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18. SUPPLEMENTARY NOTES This report consists of the following volumes: I. Indices II. Annotated Bibliography		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Pulsed Power                      Insulation Breakdown Studies              Particle Beam Generation Diagnostics                      Power Conditioning Energy Storage                  Switching		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Pulsed power and high-voltage technologies are playing an ever increasing role in weapons' effects simulation, fusion power research, power distribution, materials processing and medical research. It is a rapidly expanding field of applied physics as evidenced by the growth in published literature. Three years ago, the Air Force Weapons Laboratory (AFWL) initiated a project to compile a computerized data base of pulsed power research papers. The data base is stored on our IBM System 2000. This AFWL Technical Report is the first release of the (over)		

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20. ABSTRACT (Continued).

bibliography to date. It contains about 2,500 full bibliographic citations, original sources, availability, key words and abstracts. There are three indices: Subject, Personal Author, and Corporate Author. There are 30 main subject headings, from Breakdown Studies to Switching. The indices are contained in Volume I. Volume II contains the citations. In addition to these entries, the data base contains about 7,500 additional titles. As these titles are added to the full bibliography, they will be published.

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# ABSTRACT

## 100 (PARTICLE BEAMS, ION)

(Generation)

### GENERATION OF ULTRA-INTENSE HEAVY ION BEAMS FOR INERTIAL CONFINEMENT FUSION

F. Winterberg

University of Nevada System, Reno, NV 89507

Journal Of Plasma Physics, Vol. 21, No. 2, pp 301-315 (04/1979).

A method of producing an intense heavy ion beam using a long drift tube is described. A beam entering the tube is compressed by varying the diode voltage and is contained by an axial magnetic field producing a high density pulse. A drift tube of 100 m can amplify a 10 GW beam to a 100 TW beam using an accelerating voltage of 1 MV and a diode current on the order of 1 KA. Scaling up to even higher beam powers is discussed. 7 Refs.

Primary Keywords: Heavy Ion Beam; Drift Tube; Combining Magnetic Field; Space Charge Neutralized; Axial Beam Compression

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## 102

(ENERGY CONVERSION, ELECTRICAL)

(Power Supplies)

### HIGH-VOLTAGE DC POWER CONDITIONER

D.L. Pruitt

PCA Corp., Moorestown, NJ 08057

IEEE Transactions On Electron Devices, Vol. ED-26, No. 10 pp 1391-1393 (10/1979).

By adapting a variation of the series inverter circuit, liberally infused with artificial line-type pulse modulator technology, an effective, simple, high performance technique has been devised. Low-frequency (50-400 Hz) transformers are eliminated by direct full-wave rectification of the AC power source. (With appropriate input filter design, power source frequencies from 50 to 400 Hz can be accommodated in one design.) A pair of suitable high-frequency thyristors alternately charge and discharge a pair of capacitors through the primary of a pulse power transformer. Since the effective frequency is high (thousands of Hz), the transformer and load filter capacitor are small compared to the equivalent normal power frequency components. Operating Q is low (approaches one), minimizing the reactive power. Regulation of the output voltage is achieved by varying the pulse recurrence frequency: from as low as zero to some maximum (e.g. 20 kHz). No-load to full-load regulation < 0.5 percent has been demonstrated. The circuit is not harmed by overload, and has a current fold-back feature. Normal operation resumes automatically when an overload is removed. 0 Refs.

Primary Keywords: DC Power Supply; Light Weight; Compact; High Efficiency

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## 103

(ENERGY STORAGE, INDUCTIVE; SWITCHES, OPENING)

(Systems; Explosive)

### INDUCTIVE STORAGE PULSE-TRAIN GENERATOR

R.D. Ford and I.M. Vitkovitsky

Naval Research Lab., Washington, DC 20375

IEEE Transactions On Electron Devices, Vol. ED-26, No. 10 pp 1527-1536 (10/1979).

Utilization of inductive storage in production of intense charged particle beams, laser beams, and hot dense plasmas of interest in thermonuclear fusion studies and in other research areas is very attractive because of its inherent compactness associated with energy storage in the form of magnetic fields. A major problem in utilizing inductive energy sources with sufficient output power for such beams and plasmas is the development of an opening switch. In some instances, repetitive pulse output is required, so that switches must open repeatedly at a frequency determined by the needs of the experiment. If only a small number of pulses is needed, then use of one switch per pulse in the train becomes a practical method for generating pulse trains with peak power determined by the performance of individual switches. Formation of pulse trains with peak pulse power in the range of 1E9 to 1E10 W was studied. This study included the investigation of single-switch elements to determine methods for extending the operating power to higher levels. 5 Refs.

Primary Keywords: Inductive Fuse; Rep-rated; Burst Mode; Experiment; Theory

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## 105

(DIAGNOSTICS AND INSTRUMENTATION)

(Voltage)

### SHIELDED, HIGH-VOLTAGE PROBES

R.E. Dellinger (1) and D.L. Smith (2)

(1) State University of New York at Buffalo, Buffalo, NY 14226

(2) AFML, Kirtland AFB, NM 87117

IEEE Transactions On Electron Devices, Vol. ED-26, No. 10 pp 1553-1555 (10/1979).

A series of high-voltage probes (approximately 300 kV) with a high input impedance (>10 kohm) and good frequency response (<100 MHz) have been built. These probes use two concentric cylinders of resistive material: the inner cylinder is the larger resistor of a voltage divider and the outer cylinder shields the inner one from the stray capacitance which would normally degrade the response. These cylinders can be made of almost any resistive material provided that certain theoretical considerations based on nonuniform field penetration and probe impedances are taken into account. The theories discussed are compared to the experimental results of several probes with different resistive materials and relative dimensions. Of primary interest are the probe's response, cost, weight, construction time, energy absorption, and system compatibility (loading and shielding). 6 Refs.

Primary Keywords: Resistive Voltage Divider; High Input Impedance; Fast Rise Time; Concentric Conducting Cylinders; Stray Capacitance Shielding

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## 109

(PARTICLE BEAMS, ELECTRON)

(Generation)

### THE EXPERIMENTAL TEST ACCELERATOR (ETA)

R.E. Hester (1), D.G. Bubb (1), J.C. Clark (1), A.W. Chesterman (1), E.G. Cook (1), W.L. Dexter (1), T.J. Fessenden (1), L.L. Reginato (1), T.T. Yake (1) and A. Helms (2)

(1) Lawrence Livermore Lab., Livermore, CA 94550

(2) Lawrence Berkeley Lab., Berkeley, CA

IEEE Transactions On Nuclear Science, Vol. NS-26, No. 3, pp 4180-4182 (06/1979).

The Lawrence Livermore Laboratory is constructing an induction linac with the following parameters: 10A, 50 nsec, 100 MHz pulse width, 5 MeV, and 2.5 MeV injector and its associated pulsed power systems. 7 Refs.

Primary Keywords: ETA; LINAC; Design Considerations; Pulsed Power

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## 114

(PARTICLE BEAMS, ION)

(Generation)

### LINEAR INDUCTION ACCELERATORS MADE FROM PULSE-LINE CAVITIES WITH EXTERNAL PULSE INJECTION

Ian Smith

Ian Smith Inc., Alameda, CA 94501

The Review Of Scientific Instruments, Vol. 50, No. 6, pp 714-718 (06/1979).

Two types of linear induction accelerator have been reported previously. In one, unidirectional voltage pulses are generated outside the accelerator and injected into the accelerator cavity modules, which contain ferromagnetic material to reduce energy losses in the form of currents induced, in parallel with the beam, in the cavity structure. In the other type, the accelerator cavity modules are themselves pulse-forming lines with energy storage and switches; parallel current losses are made zero by the use of circuits that generate bidirectional acceleration waveforms with a zero voltage-time integral. In a third type of design described here, the cavities are externally driven, and 100% efficient coupling of energy to the beam is obtained by designing the external pulse generators to produce bidirectional voltage waveforms with zero voltage-time integral. A design for such a pulse generator is described that is itself one hundred percent efficient and which is well suited to existing pulse power techniques. Two accelerator cavity designs are described that can couple the pulse from such a generator to the beam; one of these designs provides voltage doubling. Comparison is made between the accelerating gradients that can be obtained with this and the preceding types of induction accelerator. 10 Refs.

Primary Keywords: Linear Induction Accelerator; 100 Percent Efficient Energy Coupling; Bidirectional Accelerating Pulse; Accelerator Cavity

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## 118

(DIAGNOSTICS AND INSTRUMENTATION)

(Current)

### MAGNETOOPTICAL CURRENT TRANSFORMER. 1: PRINCIPLES

A. Papp and A. Hekma

Siemens AG, Munich, FRG

Applied Optics, Vol. 19, No. 22 pp. 3729-3734 (11/1980).

The authors present a method of measuring current in a high voltage line using a magneto-optical transformer. The use of optical fibers as transmission lines and current sensors, and the birefringence problems that result are discussed. 20 Refs.

Primary Keywords: Magneto-optical Current Transformer; Principles; Faraday Effect; Optical Fiber; High Voltage Isolation

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## 119

(PARTICLE BEAMS, ELECTRON)

(Generation)

### UPGRADING THE AURORA SIMULATOR

A.G. Stewart

Harry Diamond Labs., Adelphi, MD 20783

Harry Diamond Lab. Report No. HDL-TM-80-28 (10/1980).

Availability: AD A092501

NTIS

The necessary degree of control was acquired over those machine parameters that determine the bremsstrahlung dose output of the simulator, thereby improving the simulator efficiency and extending its range of applications. At a given charge voltage on the Marx generator, average dose output at the center of the test volume (TVC) was increased by approximately 20 percent, the peak dose output exceeded 50 krad (TVC) for the first time, and reproducible low dose (50 rad) at low beam energy (4 MeV) was established. One result of these improvements is that overall machine maintenance time has been reduced. 0 Refs.

Primary Keywords: AURORA; Pulsed Power; High Intensity Bremsstrahlung Production

## 123

(PULSE GENERATORS; PARTICLE BEAMS, ELECTRON)

(Systems; Generation)

### OPERATION OF A 300-KV, 100-MZ, 30-KW AVERAGE POWER PULSER

M.T. Buttram and G.J. Rohwein

Sandia Labs., Albuquerque, NM 87115

IEEE Transactions On Electron Devices, Vol. ED-26, No. 10 pp 1503-1508 (10/1979).

Applications for efficient and reliable pulse power systems with long lifetimes (>1E8 shots) are foreseen for electron-beam generators, ion-beam accelerators, and lasers leading eventually to inertially confined fusion reactors. These systems will have to be capable of continuous operation for sustained periods without requiring major maintenance or repair. High operating efficiency will be required not only to minimize power consumption but also to avoid heat buildup and consequent damage to components. The system described in this paper represents an initial effort to develop an efficient energy-handling high-voltage pulser to study the problems of long-life components. 5 Refs.

Primary Keywords: Pulse Transformer; Pulse Forming Line; Output Switch; Charging Circuit; Rep-rated; Long Lifetime

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## 124

(SWITCHES, CLOSING)

(Ignitrons)

### ORIENTATION INDEPENDENT IGNITRON

R.J. Harvey and J.R. Bayless

Hughes Research Labs., Malibu, CA 90265

2nd IEEE International Pulsed Power Conference Proceedings, pp 372-375 (06/1979).

An orientation independent ignitron (OI) has been operated at 30 kV, 15 kA with 10 microsecond wide pulses at frequencies up to 100 Hz. The cathode of the OI is a thin mercury film which is held in place by surface tension on a cooled molybdenum substrate. This device has been shown to have a basic voltage withstand of over 60 kV, trigger characteristics comparable to conventional ignitrons, a current rate of rise in excess of 10 kA/microsecond at 30 kV, and a mean stable run time at 8 kA average current of 22 s in the burst mode. Reformation of the film occurs during and following the pulse burst with a recycle time on the order of 10 min. 0 Refs.

Primary Keywords: Orientation Independent; Rep-rated; Mercury Film; Surface Tension

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127  
(PULSE GENERATORS)  
(Systems)  
POWER SYSTEM FOR A HIGH-POWER BURST MODE PULSED LOAD  
T.M. Robinson  
GEC Marconi Research Labs, Essex, UK  
IEEE Transactions On Electron Devices, Vol. ED-26, No. 10 pp 1394-1400  
(10/1979).

A novel power system, recently completed and commissioned, is described. Operating directly from an 11-kV, 50-Hz public supply, it provides the electrical energy for a burst mode, pulsed load. In each burst, the minimum energy delivered by the power system is 100 kJ at a rate of 330 kW. The pulse modulator operates at a peak charge of 105 kV and is capable of switching 200 MW over a range of pulse lengths and repetition rates. The high-voltage, high-current thyristors used as the charge, discharge, and PFN energy dump switches were specially developed four-gap CX 11998 thyristors. Supply voltage stepup transformers were designed to operate over bursts of variable pulse number, length, and rate, with the rectified unfiltered transformer output directly feeding the modulator charging circuit at up to 65 kV. Polarizing effects in the transformer core caused by the use of repetition rates equal to, or harmonically related to, the supply frequency were analyzed and effectively eliminated. Special winding techniques were developed to provide the strength and insulation for withstanding fault transients. 3 Refs.

Primary Keywords: Power Line Operation; High Energy; Rep-rated; Pulse Modulator; Direct Load Coupling

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148  
(ENERGY STORAGE, CAPACITIVE; PULSE GENERATORS)  
( Marx Generators; Marx)  
HIGH DENSITY Z-PINCH PULSE POWER SUPPLY  
W.C. Munnally, C.A. Exdahl, J.E. Hamel, K.W. Henks and L.A. Jones  
Los Alamos National Labs, Los Alamos, NM 87545  
1978 IEEE Thirteenth Modulator Symposium, pp 289-292 (06/1978).

The pulse-power supply for the High Density Z-Pinch (HDZP) experiment at LASL, described in this paper, is required to produce a peak voltage on the order of 1 MV and a peak current of 1 MA in a small, high-pressure gas load. The experimental load is a small diameter (100 micron) current filament between two electrodes spaced 10 cm apart with a 20-cm diameter coaxial return conductor. The current filament is to be initiated with an 18-J, 18-ns, Q-switched Nd:glass laser. The HDZP system consists of a 75-nH, 600-kV, 72-kJ Marx bank that resonantly charges a water-insulated intermediate storage line. A prototype of 1/12 of the system is also described. The prototype has been tested at its design values. The large system is to become operational in November 1978. 1 Ref.

Primary Keywords: Marx Generator; Pulse Forming Line; High Voltage

Secondary Keywords: Z-pinch

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143  
(ENERGY STORAGE, MECHANICAL; ENERGY STORAGE, INDUCTIVE)  
(Rotating Machines; Systems)  
MG ENERGY STORAGE AND SWITCHED PULSE POWER SUPPLY  
K.I. Selin  
The JET Project, Abingdon, Oxfordshire, UK  
1978 IEEE Thirteenth Modulator Symposium, pp 293-296 (06/1978).

For the JET (Joint European Torus) device there are four main pulse power supplies for the following loads: (a) the poloidal field circuit (b) the toroidal field magnet (c) the plasma positioning (d) the plasma additional heating. The (a) supply will be described in this paper. It is presently in the design stage at GEC Machines Limited. U.K. and is scheduled for operation in 1982. A motor-generator with integrated rotor and flywheel will be used in a pulsed mode. The time between load pulses (9 minutes) is used for acceleration of the flywheel-generator. The generator output AC is rectified in a diode converter. The nominal energy extracted from the flywheel-generator-converter (FGC) is 2600 MJ at a maximum rate of 400 MW. A magnetic energy storage is included in order to reach a still larger load power. 2 Refs.

Primary Keywords: Homopolar Generator; Power Modulation; Design Considerations; Cost Analysis

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144  
(PULSE GENERATORS; ENERGY STORAGE, CAPACITIVE)  
(Systems; Capacitor Banks)  
NEUTRINO BEAM OF THE INSTITUTE OF HIGH-ENERGY PHYSICS. V. PULSED POWER SUPPLY FOR THE NEUTRINO FOCUSING SYSTEM  
D.G. Barabov, M.Z. Bikbulatov, V.P. Oshchepkov, V.L. Rykov, A.V. Semoilov, K.Z. Tushabramishvili and A.V. Chernov  
Institute Of High-Energy Physics, Protvino, USSR  
Soviet Physics-Technical Physics, Vol. 23, No. 1, pp 53-57 (01/1978).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 48, 91-98 (January 1978).

The 350-kJ system that produces unipolar current pulses of 500 kA with length approximately 150 microseconds in the three objective lenses of the neutrino focusing system is described. The system consists of 12 capacitor-bank modules. The modules are connected in parallel with the loads by small ignitrons. The loads are cable transformers whose secondary circuits include the objective lenses of the neutrino focusing system. Schematic diagrams are given for the pulse current generator, the control system, and the monitor system. The basic capabilities of the system are described. 10 Refs.

Primary Keywords: Current Generator; Ignitron; Capacitor Bank; Pulse Transformer; 500 KA Current; 150 Microsecond Pulse Duration

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153  
(PARTICLE BEAMS, ION)  
(Generation)  
QUASI-STATIC DRIFT-TUBE ACCELERATING STRUCTURES FOR LOW-SPEED HEAVY IONS  
A. Felten and J. Knebel  
Lawrence Berkeley Lab, Berkeley CA  
Particle Accelerators, Vol. 8, pp 243-253 (01/1978).

Pulsed drift tubes are discussed as a possible method of accelerating high current bunches at low energies. Several setups for voltage sources and switches which could be used to generate the 1 MV pulses to drive the drift tubes are discussed. Pulse shaping and the drift tube structure are also considered. 9 Refs.

Primary Keywords: Drift-tube; Accelerator; Pulse Shaping; Drift-tube Systems

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161  
(ENERGY CONVERSION, THERMAL)  
(Loads)  
LOADS FOR HIGH-POWER TESTING  
B.R. Gray  
Rome Air Development Center  
1978 IEEE Thirteenth Modulator Symposium, pp 70 (06/1978).

The designer or test engineer of high-power systems is often faced with the problem of substituting a load for some portion of the system for the purpose of evaluating some other components in the system, trouble shooting, checkout of the system, calibration, or for system optimization. To be a truly equivalent load it must match the normal load in its reactive and resistive power relationship, its voltage/current ratio as a function of time, power-absorbing ability, polarity, and many other factors. A test load may be required anywhere between the prime power source and the final output. It could mean a load bank on a large AC or DC power line or transformer/rectifier, a pulse-type load in the power conditioner stages of the system, or the energy output of the total system. An example of some substitute loads discussed would be an rf load on the output of an rf amplifier, beam energy absorbers in accelerators, pulsed power load at the video level, and equivalent diode loads for modulators, etc. 0 Refs.

Primary Keywords: Design Considerations

Secondary Keywords: Abstract Only

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162  
(PULSE GENERATORS)  
(Reviews)  
PULSED POWER FOR EMP SIMULATORS  
I.D. Smith and H. Aslin  
Physic International Co, San Leandro, CA 94577  
IEEE Transactions On Antennas And Propagation, Vol. AP-26, No. 1, pp 53-59 (01/1978).

Simulation of nuclear weapons effects has been the main motivation for pulse power development in the U.S. in the last decade. EMP simulation has been required for a major class of pulse power systems. A general survey of pulse power techniques is given, focusing of those particularly applicable for EMP simulation. This is followed by brief description of several representative simulators. 12 Refs.

Primary Keywords: Marx Generator; L-C Generator; Stacked Line Generator; Insulation; Switching; EMP Simulation

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164  
(PARTICLE BEAMS, ELECTRON; PULSE GENERATORS)  
(Generation; Spiral)  
SIMPLE, PULSED, ELECTRON BEAM GUN  
C.A. Brau (1), J.L. Raybun (1), J.B. Dodge (2) and F.M. Gilman (2)  
(1) Los Alamos National Labs, Los Alamos, NM 87545  
(2) Avco Everett Research Lab, Inc, Everett, MA 02149  
Review Of Scientific Instruments, Vol. 48, No. 9 pp 1154-1160  
(04/1977).

The construction of a simple, inexpensive electron beam gun is described. The pulsed power supply consists of a homemade spiral generator, constructed with aluminum and vinyl pressure-sensitive tape which is switched into the electron beam gun with a spark gap. The electron beam gun itself consists of a vacuum diode with a cold carbon cathode. From an initial charge voltage of 12 kV, the apparatus produces a 10-A beam of 100-keV electrons having a pulse duration of about 7 nsec and diameter of 6 mm. 6 Refs.

Primary Keywords: E-Beam Gun; Spiral Generator; Vacuum Diode

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166  
(POWER CONDITIONING)  
(Pulse Transformers)  
THE 10 MILLISECOND 150 KILOAMPERE PULSED POWER SUPPLY FOR THE FERMILAB NEUTRINO FOCUSING HORN  
R.C. Trandler  
Fermi National Accelerator Lab, Batavia, IL 60510  
IEEE Transactions On Nuclear Science, Vol. NS-26, No. 3, pp 3977-3979  
(06/1979).

In order to provide the long spill (one millisecond) necessary for simultaneous operation of the 15-Foot Bubble Chamber Neutrino experiments and counter experiments, the existing short pulse (20 microseconds) Neutrino Focusing Horn power supply was extensively modified. A large high current (200 kA) pulse transformer was procured and installed to modify the circuit impedances. The changing of the electrical characteristics of the system, protection systems, and installation of the transformer will be discussed. 4 Refs.

Primary Keywords: Pulse Transformer; Long Pulse; Sinusoidal Pulse; Capacitor Bank; Ignitron; System Protection

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174  
(POWER TRANSMISSION)  
(Transmission Lines)  
SPACE-CHARGE EFFECTS IN LONG COAXIAL VACUUM TRANSMISSION LINES  
J.W. Poukey and K.D. Bergeron  
Sandia Labs, Albuquerque, NM 87115  
Applied Physics Letters, Vol. 32, No. 1, pp 8-10 (01/1973).

A new two-dimensional time-dependent electromagnetic particle code is applied to the high-voltage pulsed power flow problem in a long self-magnetically insulated coaxial line. It is found that the current leakage occurs only near the front of the voltage pulse, that energy transport is very efficient at high voltages, and that the electrons in the insulated region do not get close to the anode. 11 Refs.

Primary Keywords: Transmission Line; Magnetic Insulation; Power Flow Simulation; Numerical Calculation; 2-d Particle Code

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178  
(DIAGNOSTICS AND INSTRUMENTATION; ENERGY CONVERSION, ELECTRICAL)  
(Systems; Power Supplies)

A FACILITY FOR TESTING HIGH POWER DC, AC, OR PULSED DEVICES  
R. M. Miller, P. T. Glinko, and A. S. Gilmour Jr.  
State University of New York at Buffalo, Buffalo, NY 14226

1976 IEEE Pulsed Power Conference Proceedings, Paper IIE-7 (11/1976).  
A fully instrumented facility being developed for the high power testing of pulsed-power and other devices is described. A bank of lead-acid batteries provides the facility with a power source having a maximum discharge capacity of 1.8E9 joules; the batteries can be switched into various series-parallel configurations to realize voltage-current combinations up to 10 kV at 250 A. The battery bank output terminals can be turned on and off at the test bench with a vacuum arc switch if desired. A high vacuum pumping station is built into the test bench for those devices requiring evacuation. An inverter using vacuum arc switches is being developed to convert the power to a sinusoidal AC source having a suitable frequency of up to 10 kHz. The battery bank operation is monitored and controlled either manually or by a microprocessor-based instrumentation system. The instrumentation system automates the battery charging cycle and shuts off the system whenever hazardous conditions develop in the facility during either the charge or the discharge cycle. Among the applications being investigated for the facility are the pulse and duration testing of vacuum arc switches and the development of a high-power test facility.

Primary Keywords: Pulsed Power Test Facility; Battery; Very High Energy; Medium Voltage; Microprocessor-based Instrumentation  
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179  
(SWITCHES, OPENING)

(Explosive Fuses)

A METHOD FOR ENHANCING EXPLODING ALUMINUM FOIL FUSES FOR INDUCTIVE STORAGE SWITCHING

D. Conka, M. Friedman and M. Gr...

Naval Research Lab, Washington, DC 20375

1976 IEEE Pulsed Power Conference Proceedings, Paper IID-7 (11/1976).

The success of inductive storage systems is dependent on the development of fast, low loss opening switches. An approach to this problem is to stage several successively faster switches, such as circuit breakers and fuses, in a manner so as to minimize overall losses while achieving an effective fast opening time. In this paper, we discuss the properties of an aluminum foil fuse immersed in water or hydrogen peroxide for use as one of the final fast acting elements. Although it has been shown that the time to explosion is dependent on the fuse material, peak current amplitude, and rise time, we speculate that the opening characteristics are also influenced by chemical reactions and heat transfer with the surrounding medium. Data is presented showing that the final resistivity can be optimized by proper foil dimensions and further increased by the use of chemically more active surrounding medium such as hydrogen peroxide. 4 Refs.

Primary Keywords: Inductive Energy Storage; Exploding Fuse; Low Loss; Hydrogen Peroxide Medium  
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180  
(SWITCHES, CLOSING; SWITCHES, OPENING)

(Vacuum Tubes; Vacuum Tubes)

HIGH VOLTAGE SWITCH PERFORMANCE OF THE EIMAC X-2159 TETRODE

B. R. Gray

RADC, Griffiss AFB, NY 13440

1976 IEEE Pulsed Power Conference Proceedings, Paper IC-4 (11/1976).

High Power Tetrodes designed as RF power amplifiers often times have excellent characteristics that enhance their performance when used as switch tubes. The paper reports on the test and evaluation of one such high power tetrode, the EIMAC X-2159. This tube has a design anode dissipation rating of 1.25 megawatts average power and the cathode grid and screen have very substantial ratings. The objective of the test was to determine the maximum achievable pulsed power with this tube. One main data point of interest was a pulsed current of 1000 amperes-10-20 microseconds and 50 kV hold-off. This point has been achieved. Further testing is planned to fully evolve the limits. Problems encountered included secondary emission causing the load pulse to increase in length as if it were a function of primary emission from grid. Other features of the tube to be discussed will be the ability to interrupt a faulted load current pulse and its overall operating stability. 8 Refs.

Primary Keywords: EIMAC X-2159 Tube; Operational Parameters; Test Results

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182  
(PULSE GENERATORS)

(Systems)

MAGNETIC FIELD CALCULATIONS FOR HIGH-ENERGY PULSED POWER SUPPLIES

E. B. Becker, M. D. Briggs, R. D. Pillsbury, H. G. Rylander, W. F. Weldon and M. H. Woodson

University of Texas at Austin, Austin, TX 78712

1976 IEEE Pulsed Power Conference Proceedings, Paper IIIE-2 (11/1976).

The accurate calculation of the magnetic fields, steady or rapidly varying, is extremely important in designing pulsed power supplies for controlled thermonuclear fusion experiments, lasers, etc., where the traditional simplifying assumptions become unacceptable - especially when ferromagnetic materials in high magnetic fields are used. A finite element method for solution of Maxwell's equations for a moving media in terms of the magnetic vector potential and electrokinetic scalar potential describing the penetration of the magnetic fields in fast pulsing power supplies of electromechanical type is presented. The formulation for the steady-state magnetic fields in nonlinear media results as a particular case of the method. This approach was used for predicting the discharge parameters for the very fast discharging homopolar machine (FDX) designed by the Energy Storage Group at the University of Texas. FDX is in an advanced state of execution. This work was supported by the Electric Power Research Institute (EPRI) and the Energy Research and Development Administration (ERDA). 6 Refs.

Primary Keywords: Magnetic Field Calculation; Steady State; Pulsed; High Current; Numerical Solution; Finite Element  
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184

(ENERGY STORAGE, INDUCTIVE)

(Reviews)

PULSE POWER SYSTEMS EMPLOYING INDUCTIVE ENERGY STORAGE

T. F. Frost, P. E. Garrison and T. R. Burkes

Texas Tech University, Lubbock, TX 79409

1976 IEEE Pulsed Power Conference Proceedings, Paper IID-1 (11/1976).

Basic circuits for utilizing inductive energy storage in high-power pulsers are compared in order to judge overall system performance. The comparisons are made from the standpoint of the power requirements and efficiencies for inductor charging and the switching times and efficiencies for discharging into the load. The response of several circuits are calculated, and the trade-offs in performance are discussed. 5 Refs.

Primary Keywords: Inductive Energy Storage; Performance Comparison; Design Considerations

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186

(ENERGY STORAGE, INDUCTIVE)

(Systems)

SUPERCONDUCTIVE INDUCTOR STORAGE AND CONVERTERS FOR PULSED POWER LOADS

N. G. G. (1) and H. A. Peterson (2)

(1) University of Minnesota, Minneapolis, MN

(2) University of Wisconsin, Madison, WI

1976 IEEE Pulsed Power Conference Proceedings, Paper IID-6 (11/1976).

There is a foreseeable need for supplying repetitively pulsed power loads of large magnitudes, with peaks of hundreds of megawatts or more. The nature of such loads can be expected to be as diverse as their application and the pulse durations may range from less than a microsecond to many seconds or minutes. In this paper, loads with pulse durations greater than several milliseconds are considered. The pulsed power demand and corresponding volt-ampere requirement are undesirable from the frequency and voltage fluctuation standpoint, even for the largest utility power systems. For large pulsed energy magnitudes, superconductive inductor storage may be economically employed to reduce the power pulses on the utility system. In this paper, several schemes of interconnecting the pulsed load and the storage inductor are compared in terms of the pulsed power and reactive volt-ampere requirements imposed on the power system. The effects of the storage inductor capacity and the power ratings of the interface converters are explored. A partial or complete elimination of pulsed power and reactive volt-ampere demands on the power system are possible through proper design. 3 Refs.

Primary Keywords: Inductive Energy Storage; Long Pulses; Rep-rated; Inductive Load

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187

(ENERGY STORAGE, INDUCTIVE; PULSE GENERATORS)

(Systems; Flux Compression)

TERAULT PULSE POWER SYSTEMS UTILIZING INDUCTIVE STORAGE

E. C. Chere, M. Cowan, W. K. Tucker, W. B. Leisher and D. L. Wessenberg

Sandia Labs, Albuquerque, NM 87115

1976 IEEE Pulsed Power Conference Proceedings, Paper IID-4 (11/1976).

This paper describes a system which employs a superconducting magnet, a generator coil, and nondestructive magnetic flux compression to produce pulsed power. Power in the terawatt range is predicted for full-scale systems suitable for both laser and e-beam applications of the future. Small-scale experiments are described which employed radially expanding aluminum tubes or plasma to produce peak powers of 0.5 gigawatt. 7 Refs.

Primary Keywords: Superconductive Magnet; Magnetic Flux Compression; Generator; Nondestructive; Pulsar

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188

(ENERGY STORAGE, INDUCTIVE; ENERGY STORAGE, MECHANICAL)

(Systems; Rotating Machines)

THE NRL MULTI-MEGAJOULE INERTIAL-INDUCTIVE ENERGY STORAGE SYSTEM

W. H. Lupton, A. E. Robson and W. L. Warrick

Naval Research Lab, Washington, DC 20375

1976 IEEE Pulsed Power Conference Proceedings, Paper IID-3 (11/1976).

In the NRL multi-megajoule pulse power system, energy is transferred from inertial storage (flywheels) to inductive storage by a self-excited homopolar generator. Reliable operation of the inertial storage at 5 MJ per flywheel is obtained from recent improvements in flywheel mounting, bearing lubrication, cooling and hydraulic power systems. This approach to energy conversion is only possible by use of copper-graphite fiber brushes which can follow rapid variations in wheel radius. Experimental efforts are being devoted to reducing the presently high frictional wear of these brushes. 3 Refs.

Primary Keywords: Inertial Energy Storage; Inductive Energy Storage; Multi-megajoule; Copper and Graphite Fiber Brushes

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189

(POWER TRANSMISSION)

(Transmission Lines)

VLIN, AN EFFICIENT ALGORITHM FOR MODELING VARIABLE IMPEDANCE TRANSMISSION LINES

C. H. Jones Jr.

Pulsar Associates Inc, San Diego, CA 92121

1976 IEEE Pulsed Power Conference Proceedings, Paper IIIC-8 (11/1976).

Transmission lines with a variable impedance are the most practical means for performing impedance transformation in large pulsed power machines. An effective and practical calculation technique is required which can provide adequate modeling of expected machine performance as a part of engineering design analysis. An efficient algorithm has been developed for modeling a transmission line characterized by an impedance which varies as an arbitrary but continuous function over the length of the line. A FORTRAN subroutine incorporating the algorithm is discussed. Comparisons of the algorithm results with the analytic solutions by Schatz and Williams for the special case of the exponential tapered line are shown. The algorithm employs transmission and reflection coefficients that realistically model the response of the line to the high frequencies which are especially of interest in pulsed power work. The traditional approximation of considering such a line to be a series of short segments of constant impedance implicitly ignores the high frequencies and converges more slowly as a result. 1 Refs.

Primary Keywords: Variable Impedance; Impedance Transformation; Modeling; Analysis; Computer Simulation

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- 191  
(ENERGY STORAGE, MECHANICAL)  
(Rotating Machines)  
APPLYING A HOMOPOLAR POWER SUPPLY TO A TOKAMAK  
P. Wildt, S. Hutchins and M. Driga  
University of Texas at Austin, Austin, TX 78712  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIB-5 (11/1976).  
The new Texas Experimental Tokamak will use homopolar generators as a pulsed power source. The high current, low voltage output of such a source calls for unusual solutions to achieve a proper match to toroidal coil system and ohmic heating system. The paper discusses several possible alternatives. The solutions chosen for both the toroidal and the heating coil system are described including some of the salient components such as switches and power electronics. 3 Refs.  
Primary Keywords: Homopolar Generator; Application; Impedance Matching  
Secondary Keywords: Tokamak Toroidal Field Coil  
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- 194  
(ENERGY STORAGE, CAPACITIVE; PULSE GENERATORS)  
(Capacitor Bank); (Capacitor Banks)  
MODULAR FAST CAPACITOR BANK FINAL REPORT  
P. D'A. Champney  
Physic International Co. San Leandro, CA 94577  
ATUL Report No. 74-132 (04/1975).  
Avail: NTIS; AD A010042  
NTIS  
The report describes the development of a fast capacitor bank module storing 55 kJ at 100 kV DC, capable of operation by itself or as part of a larger system. The module is gasketed and utilizes two triggered gas-discharge rail switches operable over the voltage range 15 to 50 kV DC. The module inductance is 8 nH. 10 Refs.  
Primary Keywords: Energy Storage; Capacitor Bank; Low Inductance Switches; Rail Gun
- 196  
(PARTICLE BEAMS, ELECTRON)  
(Systems)  
INITIAL PROTO II PULSED POWER TESTS  
D. L. Johnson  
Sandia Lab., Albuquerque, NM 87115  
1976 IEEE Pulsed Power Conference Proceedings, Paper IE-2 (11/1976).  
The Proto II electron beam accelerator is being developed by Sandia Laboratory to study engineering and physics aspects of electron beam pellet fusion. Currently the Marx generator-water capacitor portion of Proto II is undergoing high voltage testing and timing measurements. Eight 112 kJ Marx generators form the primary energy storage system. Each Marx generator pulse charges two parallel 7.5 nF water capacitors to 3 MV. The water capacitors act as intermediate energy storage elements and will transfer their energy to the water insulated pulse-forming lines in 250 ns by means of eight air-sub 6/ gas insulated, trigatron switches. Test data and design considerations of the trigger systems, Marx generators, water capacitors, and trigatron switches will be presented. 5 Refs.  
Primary Keywords: Proto II; E-beam; Marx Generator; Pulse Shaping; Test Data; Design Considerations  
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- 198  
(PARTICLE BEAMS, ION; INSULATION, MAGNETIC)  
(Generation)  
MAGNETICALLY INSULATED PULSE POWER DRIVEN LINAC  
F. Minterberg  
University of Nevada System, Reno, NV 89507  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIC-7 (11/1976).  
It is shown that a linear accelerator of modest dimensions using magnetically insulated accelerating segments and driven by electric pulsed power sources can accelerate intense beams of heavy ions to multi-GeV energies. The most important application of such an accelerator would be for the ignition of thermonuclear microexplosions but it could also ideally serve as a research tool for heavy ion induced nuclear reactions. 10 Refs.  
Primary Keywords: Linac; Magnetic Insulation; Heavy Ion Beam; Microparticles; Very High Energy  
Secondary Keywords: Thermonuclear Microexplosion  
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- 199  
(SWITCHES, CLOSING)  
(Thyristors)  
NEW OPTIONS IN PULSE POWER UTILIZING LASS SWITCHES  
O. Zucker  
Lawrence Livermore Lab., Livermore, CA 94550  
1976 IEEE Pulsed Power Conference Proceedings, Paper IB-6 (11/1976).  
Light Activated Silicon Switches are high power, fast rise time, semiconductor devices which open new possibilities in the pulse field. Specifically, the distributed nature of the current path and the sub nanosecond rise time of these devices enables 0 Refs.  
Primary Keywords: Light Activated Silicon Switches; Fast Rise Time; Rep-rate  
COPYRIGHT: 1976 IEEE, REPRINTED WITH PERMISSION
- 201  
(ENERGY STORAGE, MECHANICAL)  
(Rotating Machines)  
PULSED POWER FROM INERTIAL STORAGE WITH HOMOPOLAR MACHINES FOR CONVERSION  
M.M. Woodson, M.G. Rylander and W.F. Meldon  
University of Texas at Austin, Austin, TX 78712  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIB-1 (11/1976).  
Because of its simplicity, an inertial energy storage with a homopolar machine for conversion can provide a relatively inexpensive pulsed-power supply for some important applications. The fundamental principles of operation of homopolar machines are given along with configurations that have been used or proposed and scaling laws for each configuration. Operating characteristics and costs are described as functions of energy level, discharge time and voltage level. The physical limitations on system performance are described to define the ranges of applicability of the concept. 4 Refs.  
Primary Keywords: Homopolar Generator; Operating Characteristics; Limitations  
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- 204  
(ELECTROMAGNETIC COMPATIBILITY)  
(Grounding And Shielding)  
SALVING DIAGNOSTICS IN THE PULSE-POWER ENVIRONMENT  
R.A. Fitch  
Maxwell Labs Inc., San Diego, CA 92123  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIID-5 (11/1976).  
Contacted oscillograms and outraged equipment are a commonplace of pulse-power systems. This paper attempts to explain why and what to do about it. 0 Refs.  
Primary Keywords: Shielding; Noise Suppression; Short Pulse Operation; Noise Coupling  
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- 205  
(REVIEWS AND CONFERENCES)  
(Reviews)  
THE EVOLUTION OF PULSED POWER  
G.K. Simcox, J.J. Moriarty and T.J. Griffin  
Raytheon Co., Bedford, MA 01730  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIIE-1 (11/1976).  
A review of pulse power developments is presented from the viewpoint of low duty-cycle, high power, high voltage generator technology. The effects of increasing duty-cycle upon dielectrics, switching, reactor form and engineering problems are briefly discussed. Factors of importance of power conditioning and prime power management, the limitations and fundamental importance of pulsed power techniques are explored with reference to the Controlled Thermonuclear Reaction field. 4 Refs.  
Primary Keywords: Pulsed Power Development; Nonrep-rated; Power Conditioning; Rep-rated; Limitations  
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- 206  
(PULSE GENERATORS)  
(Miscellaneous)  
THE PLASMA FOCUS AS A PULSED POWER SOURCE FOR DRIVING FU MICROEXPLOSIONS  
H.L. Sahlin  
Lawrence Livermore Lab., Livermore, CA 94550  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIIE-6 (11/1976).  
The plasma focus is a very remarkable device. Careful study of the focus phenomenon reveals that nature has provided a means of time energy compression superior to most if not all inventions in this field. The focus provides a means of converting relatively slow capacitive energy storage into energy of a rapidly imploding plasma shell and high density inductive stored energy behind this plasma shell. The focus then acts as its own switch by suddenly changing the r-z pinch resistivity by a factor that can exceed 100, and as a result inductive energy is converted into heating of the dense plasma which now acts as a target. The mode of energy concentration of the focus into its own self switching pinch provides a natural mode of operation that may be more effective than the various means that have been proposed for burning a DT microexplosion. We will review the efforts at Livermore to drive fusion microexplosion with the plasma focus utilized as a self-switched pulse power source. The physical phenomenon involved in interrupting the current followed by restrike of the current either as a relativistic electron burst or as short duration ion burst, depending on the operating conditions, will be treated in detail. The relation of our work at LLNL to similar efforts in the Soviet Union will be presented, and the similarity to the plasma focus to the current collapse observed in low impedance relativistic e-beam diodes will be explored. 0 Refs.  
Primary Keywords: Dense Plasma Focus; Pulse Compression; Opening Switch  
Secondary Keywords: Fusion Driver  
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- 208  
(PULSE GENERATORS)  
(Electrostatic)  
VARIABLE CAPACITANCE ELECTROSTATIC ELECTRICAL PULSE GENERATOR  
O.P. Breueux  
Air Force Avionics Lab., Wright-Patterson Air Force Base, OH 45433  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIIE-8 (11/1976).  
Variable capacitance electrostatic generators are capable of rugged efficient operation and high power output. An exposition is given of a variable capacitance electrostatic energy conversion system, employing self-contained excitation, for electrical pulsed power generation, including mathematical analysis and comment on practical realization. 10 Refs.  
Primary Keywords: Electrostatic Pulse Generator; Variable Capacitance; High Efficiency; High Power; Analysis  
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- 215  
(ENERGY STORAGE, INDUCTIVE)  
(Systems)  
DESIGN AND CONSTRUCTION OF AN INDUCTIVE STORAGE UNIT FOR LASER PUMPING  
I. I. Artemov, B.A. Barikhin, V.V. Borovkov and V.I. Keshintsov  
Sov. J. Quantum Electron., Vol. 9, No. 1 pp 70-73 (01/1979).  
Trans. From: Kvantovaya Elektron. (Moscow) 6:127-133 (January 1979)  
Analytic expressions are presented for an exploding wire switched inductive energy storage system. A model is derived for the case of complex impedance loads (inductance and capacitance) and results are compared to an experiment utilizing a flash lamp as a complex impedance load. Power into the load is seen to be increased over that delivered by capacitance energy storage. 9 Refs.  
Primary Keywords: Inductive Storage; Exploding Wire; Complex Loads; Theory; Experiment  
Secondary Keywords: Laser Pumping; Flash Lamps; Circular Spark Gap  
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- 217  
(SWITCHES, CLOSING)  
(Thyristors)  
HIGH FREQUENCY THYRATRON EVALUATION  
G.A. Hill (1) and R. Burkes (2)  
(1) BDM Corporation  
(2) Texas Tech University, Lubbock, TX 79409  
2nd IEEE International Pulsed Power Conference Proceedings, pp 364-367 (06/1979)  
The high frequency characteristics of a triple grid thyatron are investigated. The triple thyatron has three closely spaced grids and operates much like a conventional tetrode thyatron. The first grid has a dual function. It functions as a priming grid, preionizing the grid cathode space, as well as a shield grid, isolating the control grid from the cathode plasma during the recovery phase. The second grid is the control grid, with negative control characteristics. The third grid is a shield grid, designed to enhance the control grid aperture deionization. This thyatron is tested in a line-type pulser to determine its high frequency limitations. It proves capable of operating at pulse repetition frequencies of up to 180 kHz. 2 Refs.  
Primary Keywords: Pentode Thyatron; Priming Grid; Control Grid; Shield Grid; Ionized; Line-type Pulser; Fast Rise  
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219  
(SWITCHES, CLOSING)  
(Thyratrons)

HOLLOW-ANODE MULTIGAP THYRATRONS

H. Monoun and C.V. Meale  
English Electric Valve Co Ltd, Chelmsford, Essex, UK  
2nd IEEE International Pulsed Power Conference Proceedings, pp 363  
(06/1979).

Subsequent to the introduction of single-gap, hollow-anode tubes in 1978, a new range of multigap hollow-anode tubes is being introduced. There are many applications where high rates of rise of reverse voltage cause premature failure of conventional multigap thyratrons due to arc-back. One solution has been to use double-cathode tubes, which are capable of reverse conduction without deterioration of performance. The hollow-anode tubes offer the similar advantage of tolerating reverse conduction without requiring extra high-voltage-isolated supplies. The operation of these tubes in low-inductance circuits is compared with conventional solid-anode tubes. 0 Refs.

Primary Keywords: Arc-back; Comparison With Solid Anode Tube

Secondary Keywords: Abstract Only

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221  
(ELECTROMAGNETIC LAUNCHERS)  
(Reviews)

ELECTROMAGNETIC GUNS, LAUNCHERS AND REACTION ENGINES

H. Kelm, P. Fine, P. Williams and P. Monaghan  
Massachusetts Institute of Technology, Cambridge, MA  
2nd IEEE International Pulsed Power Conference Proceedings, pp 42-48  
(06/1979).

Recent advances in energy storage, switching and magnet technology make electromagnetic acceleration a viable alternative to chemical propulsion for certain tasks, and a means to perform other tasks not previously feasible. Launchers of interest include the DC railgun driven by energy stored inertially in a homopolar generator and transferred through a switching inductor, and the opposite extreme, the synchronous mass driver energized by a high voltage alternator through an oscillating coil-capacitor circuit. A number of hybrid variants between these two extremes are also promising. A novel system described here is the momentum transformer which transfers momentum from a massive chemically driven armature to a much lighter, other velocity projectile by magnetic flux compression. Potential applications include the acceleration of green-size particles for hypervelocity research and for use as reaction engines in space transport; high velocity artillery; stretchersize tactical supply and medical evacuation vehicles; the launching of space cargo or nuclear waste in one-ton packets using off-peak electric power. 21 Refs.

Primary Keywords: Electromagnetic Propulsion; Railguns; Synchronous Mass Driver; Flux Compression Generator; Superconducting

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223  
(SWITCHES, CLOSING)  
(Thyratrons)

NEW HYDROGEN THYRATRONS FOR ADVANCED HIGH POWER SWITCHING

D. Turnquist (1), R. Caristi (1), S. Friedman (1), S. Herz (1), R. Plante (1) and N. Reinhardt (2)  
(1) EG&G Inc, Salem, MA 01970  
(2) Consultant, Lexington, MA  
2nd IEEE International Pulsed Power Conference Proceedings, pp 17-24  
(06/1979).

Recent advances in high power switching have led to the development of new hydrogen thyratrons operating at high pr and high di/dt with low jitter and long life. Short commutation times, dependent on internal pressure and geometry, and on the method of triggering, combine with inductance less than 14 nH/kV to give di/dt on the order of 1612 amperes per second. Experimental results are in agreement with those predicted by newly derived theoretical models. Operation at peak currents up to 75 kA has been achieved for 10 microsecond pulses, and much higher currents can be achieved at shorter pulse widths. Tests at 1 MW of average power have verified thyratron scaling laws at tens of amperes average and kiloamperes r.m.s. Thyratron operation at average power levels far in excess of 1 MW is possible. 8 Refs.

Primary Keywords: High di/dt; Low Jitter; High Currents; Very High Power; Triggering; Pulse Charging

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224  
(ENERGY CONVERSION, ELECTRICAL; POWER CONDITIONING)  
(Charging Circuits; Pulse Transformers)

OFF-RESONANCE TRANSFORMER CHARGING FOR 250-KV WATER BLUMLEIN

E.G. Cook and L.L. Reppato  
Lawrence Livermore Lab, Livermore, CA 94550  
IEEE Transactions On Electron Devices, Vol. ED-26, No. 10 pp 1512-1517  
(10/1979).

An off-resonance transformer for charging a 250-kV Blumlein system provides a viable alternative to other charging schemes by permitting the use of conventional thyratrons. Such a transformer must have reliability, a reasonable voltage stepup, and a non-reversing primary current. This paper presents the analysis, design, and performance data for such a transformer. The strong interrelationship between transformer design and Blumlein requirements necessitates that Blumlein description and design criterion be briefly presented prior to transformer design such that transformer load requirements be defined. 6 Refs.

Primary Keywords: Off-resonance Transformer; Non-reversing Primary Current; Thyratron Switching; Blumlein Line

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225  
(PULSE GENERATORS)  
(Capacitive)

SIMPLE, FAST RISE TIME, HIGH REPETITION RATE POKELS CELL DRIVER

B. Plourde, P. Mack and E. Verro  
Evo Everett Research Lab Inc, Everett, MA 02149  
The Review Of Scientific Instruments, Vol. 51, No. 4, pp 549-550  
(04/1980).

A thyratron Pockels cell driver capable of optically switching pockels cells of up to 2.5 cm aperture in 6 ns at repetition rates of up to 100 Hz is described. The circuit is based on a modified MY-2 thyratron. 3 Refs.

Primary Keywords: Pulse Generator; Thyratron; 5 kV Operating Voltage; 6 ns Rise Time; Rep-rated; Low Energy

Secondary Keywords: Pockels Cell Driver

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231  
(SWITCHES, CLOSING)  
(Thyratrons)

ADVANCES IN THE DEVELOPMENT OF A GAS DISCHARGE SWITCH HAVING A REPETITIVE CURRENT INTERRUPTING CAPABILITY

R.F. Caristi, R.P. Simon and D.V. Turnquist  
EGIG Inc, Salem, MA 01970

1978 IEEE Thirteenth Modulator Symposium, pp 227-234 (06/1978).  
The practical applications of a repetitively openable and closable high current, high voltage switch have resulted in considerable interest in the phenomenon of current interruption in a conducting gas by the application of a transverse magnetic field to a gas discharge channel. Such a switch is useful as a series-connected protective device, a controllable charging diode, a mechanical for the generation of variable width pulses at high power levels, and as a regulating device for high power, high voltage sources. The physical basis for magnetic current interruption has been shown to be the action of the  $\mathbf{J} \times \mathbf{B}$  force on the gaseous conductor. This force serves to drive the gas against a suitably chosen channel sidewall such that the impedance of the discharge rapidly increases as recombination takes place. The geometry of the discharge channel is thus important in the design of a practical magnetic interrupter. 8 Refs.

Primary Keywords: Gas Gaps; Opening Switch; Transverse Magnetic Field; "Shut-down" Discharge Channel; Hydrogen Thyratron

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233  
(SWITCHES, CLOSING)  
(Thyratrons)

DEVELOPMENT OF A FORTY KILOVOLT MEGAWATT AVERAGE POWER THYRATRON

J. Hamilton (1), S. Herz (1), R. Plante (1), D. Turnquist (1), N. Reinhardt (2), J. Creeden (3) and J. McGowan (3)

(1) EGIG Inc, Salem, MA 01970  
(2) Consultant, Lexington, MA  
(3) FCOM, Fort Monmouth, NJ 07703  
1978 IEEE Thirteenth Modulator Symposium, pp 135-143 (06/1978).

The thyratron which resulted from the MAPS-40 Megawatt Average Power Switch development effort achieved switching of 40 kV and 43 kA with a pulse width of 10 microsecond and a repetition rate of 125 Hz. Operated in bursts in 10 to 15-second bursts at the 1-megawatt average power level. The MAPS-40 embodies new engineering solutions to the problems encountered in high power thyratrons. In this development, careful attention had to be given to the control of operating dissipation, to the storage and disposal of heat, to the strength and protection of internal tube structures, and to the special requirements of tube and circuit operation at the megawatt level. In the first phase of the program, eight thyratrons were constructed, five of which were delivered to Fort Monmouth for evaluation. Four of these prototype tubes were tested to the specified objectives in short-burst operation, and were subjected to further tests to explore their normal design capabilities. Seven more tubes have since been built, all of the same design, all of which have met the specified objectives. 3 Refs.

Primary Keywords: MAPS-40 Thyratron; Ceramic Thyratron; Rep-rated; High Average Power; Design Considerations

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235  
(SWITCHES, CLOSING)  
(Thyratrons)

DOUBLE GAP METAL ENVELOPE THYRATRONS

R.J. Wheldon  
English Electric Valve Co Ltd, Chelmsford, Essex, UK  
1978 IEEE Thirteenth Modulator Symposium, pp 113-116 (06/1978).  
The metal envelope thyratron has established itself as a versatile switch capable of high power service over a wide range of duties. The compact barium aluminate cathode used in these tubes gives a long life at both high peak and high average currents and the metal envelope provides efficient electrode cooling under these conditions. A compact high content gas reservoir system allows direct switching at high current without gas starvation. A "boxed in" anode with the high voltage insulator behind the anode prevents material sputtered by ion bombardment in the presence of inverse voltage from degrading the insulation. This range of tubes now includes two new higher voltage versions. The paper describes the CX1525 which is capable of switching 3500 A at 70 kV and the CX1536 10,000 A at 70 kV at 5 and 10 A continuous average current respectively. It describes the grids and gradient grids which enable very short recovery times for tubes of their size (of the order of 25 microseconds), allowing operation at pr in excess of 10 kHz. An alternative method of tube operation is described, as a single gap triple grid tube, which further improves the recovery time and screens the control from fast rates of change of peak voltage. 2 Refs.

Primary Keywords: Metal Envelope; Electrode Cooling; Boxed In Anode; Multi-gap; Design Considerations

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236  
(PARTICLE BEAMS, ELECTRON)  
(Generation)

CHARACTERIZATION OF ELECTRON AND ION CURRENT FLOW IN VERY LARGE ASPECT-RATIO TERAWATT DIODES EMPLOYING HEATED AND UNHEATED ANODES

R.D. Genario and V.L. Bailey  
Physic International Co, San Leandro, CA 94577

Applied Physics Letters, Vol. 33, No. 8, pp 694-696 (10/1978).  
Electron-beam-focusing experiments using tapered hollow cathodes have been performed at power levels exceeding 1E12 W and with diode aspect ratios (radius/anode-cathode spacing) of 24 and 45 (uncorrected for plasma motion). The spatial distributions of both the electron (using collimated p-n diodes) and ion currents (using quartz pressure gauges and Faraday cups) were measured simultaneously. Six bright electron-beam pinches were produced at large R/a (approximately 24) using a diode configuration that employed a small-diameter cathode and heated anode. 5 Refs.

Primary Keywords: E-beam Diode; Tapered Hollow Cathode; Pinching; Cold Anode; Heated Anode; PITHON

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- 237  
(SWITCHES, CLOSING)  
(Thyratrons)  
FLANGE MOUNTING GLASS ENVELOPE HYDROGEN THYRATRON  
L.J. Kettle, C.V. Neale and B.P. Newton  
English Electric Valve Co Ltd, Chelmsford, Essex, UK  
1978 IEEE Thirteenth Modulator Symposium, pp 102-104 (06/1978).  
The stacked grid and anode assembly of conventional ceramic thyratrons does not provide a reservoir of neutral gas near the anode which is as large as that in a glass envelope tube. In consequence, when a trip or kick-off occurs in many pulse modulator applications, the follow through current may cause a ceramic thyratron to quench and conduct in a metallic spark mode, thus causing irreparable damage to itself. The paper describes recently developed hydrogen thyratrons which combine the advantages of the open structured glass envelope tubes, capable of high amp. second ratings for their size, with the conventional low inductance flange mountings normally associated with ceramic envelope tubes. When used in simple low inductance housing, these tubes are capable of handling rates of rise of current in excess of 50 kA/microsecond. 2 Refs.  
Primary Keywords: Glass Thyratron; Low Inductance; Fast Rise; Long Pulse  
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- 239  
(SWITCHES, CLOSING; SWITCHES, OPENING)  
(Reviews: Vacuum Tubes)  
HIGH POWER SWITCHING CAPABILITIES  
T. Burkes, M. Kristiansen, W. Portnoy and M. Hagler  
Texas Tech University, Lubbock, TX 79409  
1978 IEEE Thirteenth Modulator Symposium, pp 173-179 (06/1978).  
Various high power switches are compared with regard to their capabilities in terms of maximum hold-off voltage, peak current, pulse repetition rate, current rise time, coulomb handling capability and lifetime. The specific switches considered are thyratrons, silicon controlled rectifiers (SCR's), vacuum tubes, ignitrons and spark gaps. Information for this study was obtained from the open literature. Emphasis is placed on a switch's capability to handle rated voltage and current simultaneously. 0 Refs.  
Primary Keywords: Review; Thyratron; Thyristor; Vacuum Tube; Ignitron; Spark Gap  
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- 240  
(SWITCHES, CLOSING; PULSE GENERATORS)  
(Thyratrons: Capacitive)  
HIGH-POWER, HIGH-REpetition RATE PULSER FOR PHOTO-IMPULSE IONIZED LASERS  
V.E. Merchant, H.J.J. Seguin and J. Dow  
University of Alberta, Edmonton, Alberta, Canada  
The Review Of Scientific Instruments, Vol. 49, No. 12, pp 1631-1636 (12/1978).  
The design and operational parameters of a high-power pulser suitable for a photo-impulse ionized laser are presented. The relatively compact device utilizes a ceramic thyratron in a triggered resonant charging circuit. Efficient operation at repetition rates up to 40 kHz, with pulsed powers in excess of 2 MW and average powers of several kilowatts has been achieved. 9 Refs.  
Primary Keywords: Thyratron; Coaxial Mount; Low Inductance; Compact Construction; Low Energy; Rep-rated  
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- 244  
(SWITCHES, CLOSING; BREAKDOWN STUDIES)  
(Vacuum Gaps, Electrical; Vacuum, Electrical)  
ELECTRON CURRENT IN DELAYED TRIGGERING OF HIGH-VOLTAGE, HIGH-VACUUM PULSED DISCHARGES  
B.I. Volkov, V.B. Glasko, A.I. Dmitriev, A.B. Korshunov and E.M. Reikhrudel  
Moscow State University, Moscow, USSR  
Soviet Physics-Technical Physics, Vol. 16, No. 10, pp 1710-1716 (06/1978).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 41, 2159-2166 (October 1971)  
A model for the deintegration of metal vapors is used to find the maximum density of the electron beam impinging on the anode in delayed triggering of a pulsed discharge in high vacuum. Computer calculations (using an M-20) show that the maximum stable electron current density in a cold-cathode tube with a trigger electrode is an order of magnitude greater than the electron current density from a thermionic cathode (anode-to-cathode distance  $d = 3$  cm, voltage drop between the electrodes  $U_{sub} / d = 30$  kV). These results are found to agree with experiment. 8 Refs.  
Primary Keywords: Vacuum Gap; Metal Vapor; Modeling; Electron Flow; Numerical Calculations; Cold Cathode; Heated Cathode; Space Charge Neutralization  
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- 246  
(SWITCHES, CLOSING)  
(Thyratrons)  
NEW DEVELOPMENTS IN SUPER-FAST, HIGH-POWER, HYDROGEN THYRATRON SWITCHING  
R.F. Caristi, S. Friedman, S.S. Merz and D.V. Turnquist  
EG&G Inc, Salem, MA 01970  
IEEE Transactions On Electron Devices, Vol. ED-26, No. 10 pp 1427-1438 (10/1979).  
Design criteria for hydrogen thyratrons operating at fast rates of current rise (di/dt), high anode voltages, and high peak currents have been theoretically and experimentally determined. The approach was to divide the investigation into two basic areas. The criteria for achieving high di/dt were first established at relatively low voltages. Then the information necessary to incorporate features promoting high di/dt into a high-voltage structure was determined. The principal factors affecting di/dt are the tube's effective inductance, the nature and rate of the plasma growth, and the manner in which commutation is effected. The inductance depends on the tubes geometry and dimensions. Plasma growth is a function of geometry and gas pressure, and must be controlled in a way such that the tube is triggered and then commutates in the optimum manner for highest di/dt. Rise rates on the order of a few times  $10^{12}$  A/s are considered feasible for properly designed tubes operating with anode voltages of 50 kV and peak currents of 10 kA. 8 Refs.  
Primary Keywords: High di/dt; High Peak Current; Tube Geometry; Consideration; Current Commutation; Rep-rated  
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- 247  
(PARTICLE BEAMS, ELECTRON; POWER CONDITIONING; PULSE GENERATORS)  
(Generator: Systems; Pulse Forming Lines)  
DESIGN STUDY FOR AN AURORA MODIFICATION LEADING TO A 100-TFRWATT NUCLEAR WEAPON RADIATION SIMULATOR  
A.G. Stewart and G.A. Huttlin  
Harry Diamond Labs, Adelphi, MD 20783  
MDL Report No. MDL-TM-79-3 (02/1979).  
Availability: AD A071339  
NTIS

- 250  
(ENERGY STORAGE, MECHANICAL; PULSE GENERATORS)  
(Rotating Machines; Rotating Machines)  
DETAILED DESIGN, FABRICATION AND TESTING OF AN ENGINEERING PROTOTYPE COMPENSATED PULSED ALTERNATOR  
W.L. Bird and H.H. Woodson  
University of Texas at Austin, Austin, TX 78712  
LLI Final Report on Contract W-7405-ENG-48 (03/1980).  
The design, fabrication and test results of a prototype compensated pulsed alternator are discussed. The prototype compensator is a vertical shaft single phase alternator with a rotating armature and salient pole stator. The machine is designed for low rep rate pulsed duty and is sized to drive a modified 10 cm kVta amplifier. The load consists of sixteen 15 mm x 20 mm x 112 cm long xenon flashtubes connected in parallel. The prototype compensator generates an open circuit voltage of 6 kV, 180 Hertz, at a maximum design speed of 5400 rpm. At maximum speed, the inertial energy stored in the compensator rotor is 3.4 MJ. 1 Refs.  
Primary Keywords: Compensator; High power; Laminated rotor; Compensating windings; high average flux density; Time varying armature circuit  
Secondary Keywords: Pulse shaping; Simulation; Magnetic field mapping; Design notes
- 251  
(SWITCHES, CLOSING)  
(Thyratrons)  
THYRATRON FOR SHORT PULSE LASER CIRCUITS  
H. Menoun and C.V. Neale  
English Electric Valve Co Ltd, Chelmsford, Essex, UK  
1978 IEEE Thirteenth Modulator Symposium, pp 125-126 (06/1978).  
The conventional thyratron is a unidirectional switch; therefore when circuit design demands large current reversals (as in many short pulse laser drivers) arc back, or positive ion sweeping of the anode surface, causes metallic sputtering which soon leads to a degradation of forward voltage hold-off. A few range of tubes is described which is designed to accommodate this circuit requirement by storing plasma during the forward pulse within a hollow annular apertured anode structure. It is shown that by careful design of the grid/anode geometry, a form of bi-directional operation, without loss of forward voltage hold-off, can be obtained. Information is given concerning circuits suitable for operating these thyratrons, principally in order to avoid problems associated with recovery time. 0 Refs.  
Primary Keywords: Ceramic Thyratron; Bidirectional Operation; Short Pulse  
Secondary Keywords: Gas Laser Pumping  
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- 257  
(PULSE GENERATORS)  
(Line Type)  
A 1200 MEGAWATT VAN-MOUNTED LINE-TYPE MODULATOR  
P.A. Corbierre, R.E. Kolibas and J.J. Moriarty  
Raytheon Co, Bedford, MA 01730  
1978 IEEE Thirteenth Modulator Symposium, pp 260-263 (06/1978).  
A line-type modulator is described which operates from a 4160 V AC source and delivers repetitive 12 kJ pulses to a remote load. The module and its controls are self-contained in a 45 foot long environmentally controlled, trailerable van. The pulser is comprised of fourteen thyratron-switched modulators, command-charged from a common source and coupled to the load by means of a single output transformer and cable. Test equipment has been developed which provides system shutdown and fault identification in the event of thyratron malfunction, load fault or charging imbalance. The module has been operated into a resistive load at the following levels: Output Voltage - 165 kV, Energy per Pulse - 12 kJ, Pulse Repetition Rate - 5 g/s Shot to 25 pps, Burst Duration - 15 s, Pulse Duration - 10 microseconds and 20 microseconds. 0 Refs.  
Primary Keywords: Line-Type Modulator; Portable; Hydrogen Thyratron; High Voltage; System Protection; Command Charge; Modular Construction; Rep-rated  
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- 259  
COMPACT MEGAWATT AVERAGE POWER PULSE GENERATOR  
J.E. Creedon, J. McGowan, A.J. Buffa and S. Schneider  
ECM, Fort Monmouth, NJ 07703  
Research and development technical rept. No. DELET-TR-78-26, 6p (11/1978).  
Availability: AD-A065 113/35T  
NTIS  
No abstract available.  
Primary Keywords: Pulse Generators; Modulators; High Power  
Secondary Keywords: Burst Mode; PFN(Pulse Forming Networks); NTISDODXA
- 263  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
LOW INDUCTANCE SPARK GAP SWITCH FOR BLUMLEIN-DRIVEN LASERS  
J.W. Keto, T.D. Raymond and S.T. Walsh  
University of Texas at Austin, Austin, TX 78712  
The Review Of Scientific Instruments, Vol. 51, No. 1, pp 42-43 (01/1980).  
We report the design of a low inductance spark gap switch for Blumlein-driven lasers which is highly reliable under conditions of high repetition rate and high average power. The reported spark gap has provided reproducible pulse waveforms without maintenance for 1E8 shots in a Blumlein-driven nitrogen laser. When operated with a nitrogen-SF<sub>6</sub> sub 6/4 mixture in the laser tube, this laser provided peak powers in excess of 3 MW at 5-Hz repetition rate and an average power of 0.5 W at 120-Hz repetition rate. 4 Refs.  
Primary Keywords: Low Inductance; Copper Electrodes; Nitrogen Gap; Insulator Shield; Rep-rated; Blumlein-line  
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- 267  
(SWITCHES, CLOSING)  
(Thyratrons)  
HIGH RATE OF RISE OF CURRENT PULSE GENERATION USING LOW COST GLASS ENVELOPE THYRATRON  
R.L. Snelling (1), B.P. Newton (1), A. Andrews (2) and I. Littlewood (2)  
(1) English Electric Valve Co Ltd, Chelmsford, Essex, UK  
(2) Clarendon Lab, Oxford, UK  
1978 IEEE Pulsed Power Conference Proceedings, Paper 1B-5 (11/1974).  
The front edge switching capability of glass thyratrons can be extended many times by special re-entrant mountings and drive circuits. The paper is a practical approach to the problems involved and contains mounting details and circuits for specific tubes, along with some general theory. Detailed results are described of an experiment which compares the switching capabilities of spark gaps and glass thyratrons when used to discharge currents through a losing medium such as a helium-nitrogen mixture. 0 Refs.  
Primary Keywords: Glass Thyratron; Fast Current Rise; Pulse Generator; Rep-rated  
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# 296 (PARTICLE BEAMS, ION; PARTICLE BEAMS, ELECTRON)

(Generation; Target Interaction)  
DIELECTRIC GUIDE CONTROLLED COLLECTIVE ION ACCELERATION  
Spire Corp. Bedford, MA 01730  
AFML Report No. AFML-TR-77-248 (02/1980).  
Availability: AD A084994  
NTIS

Experiments performed at Spire and at NRL have demonstrated dielectric guide controlled collective ion acceleration. Control of the phenomenon has been established by varying the electron beam parameters or guide geometry. Specifically, it has been shown that: Total electron current must exceed the space charge limit; a minimum electron current density is required; increasing guide length (assuming the electron beam can propagate to the end) increases ion energy; increasing guide radius at constant electron current decreases ion energy; and, the energy or charge deposited per unit area of wall controls the velocity of propagation of the electron beam front and, therefore, the energy of the ions. NRL VEGA results showed that: Dielectric guide controlled collective ion acceleration is effective at higher electron beam energies; an electron beam with current pinched on axis is more efficient for ion acceleration; and, molding the surface of the guide can control the beam front velocity. 18 Refs.

Primary Keywords: Unconventional Accelerators; Collective Effect Acceleration; Dielectric Guide Control

# 298 (PULSE GENERATORS; ENERGY STORAGE, CAPACITIVE)

(Capacitor Banks; Capacitive Banks)  
A 230 KJ PULSED POWER SUPPLY

R. Minje  
Fermi National Accelerator Lab. Batavia, IL 60510  
IEEE Transactions On Nuclear Science, Vol. NS-22, No. 3, pp 1317-1320 (06/1975)

The Mason Focussing System (Horn), consisting of two singlet-curved coaxial structures, in which circular magnetic fields of varying intensity are produced, and a 230 kJ pulsed power supply have recently been built and operated at Fermilab. The development and construction of the power supply and its related control system is reported in this paper, while a companion paper published in these proceedings reports on the design and development of the magnetic structure (horns) and the interconnecting transmission line. The capacitor discharge series resonant network was chosen because of the ability to generate the required high current at a relatively modest voltage. Ignitrons are used as the switching elements. A dual set of ignitrons and their controls are connected to the capacitor bank which allows the time-shared operation of the power supply into two loads without the necessity of mechanical, high-current switching. The alternate load for the power supply is a test area where development work on a new horn system components is carried out. The power supply is located outside the Neutrino Laboratory Target Hall where the capacitor bank and ignitron switches are safely positioned in an isolated room. The associated support equipment is adjacent to the bank room. 2 Refs.

Primary Keywords: Series Resonant Network; Capacitor Discharge; Ignitron Switch; Crowbar; Modular Construction  
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# 299 (PULSE GENERATORS)

(Capacitive)  
CONSTANT PULSE ENERGY POWER SUPPLY FOR A HIGH REPETITION RATE LASER SYSTEM

C.C. Lo and B. Fan  
Lawrence Berkeley Lab. Berkeley CA  
The Review Of Scientific Instruments, Vol. 47, No. 1, pp 63-65 (01/1976)

A pulsed power supply system with constant pulse energy has been developed to drive flashlamps in a 0.5-5 pulses per second Nd:glass laser. By using a stable, absolute reference voltage source to set the trigger level, the energy discharged through the flashlamps is kept constant despite pulsing frequency change, power line fluctuation, and minimum DC power supply regulation. The concept can be expanded or adapted to operate other similar systems. 4 Refs.

Primary Keywords: Capacitor Charging; Excellent Pulse Repeatability; Slow Discharge; Output Pulse; Rep-rated  
Secondary Keywords: Nd-glass Laser Pumping  
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# 303 (DIAGNOSTICS AND INSTRUMENTATION)

(Component Testing)  
EMP SUSCEPTIBILITY OF INTEGRATED CIRCUITS

C.R. Jenkins and D.L. Durgin  
BOM Corp. Albuquerque, NM 87106  
IEEE Transactions On Nuclear Science, Vol. NS-22, No. 6, pp 2494-2499 (12/1975)

This paper summarizes the results of a major test program which involved the measurement of the pulse power failure thresholds of 41 integrated circuit types, representing seven logic families. The pulse widths used in these tests range from 0.1 microsecond to 10 microseconds. The failure threshold data have been grouped by logic family and test terminal to form failure categories. A simple failure model has been developed which is useful in predicting the failure thresholds of untested devices. 9 Refs.

Primary Keywords: Digital Integrated Circuits; EMP Testing; Failure Modes; Microsecond Pulse Widths; Modeling  
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# 308 (PARTICLE BEAMS, ELECTRON)

(Generation)  
PULSED MICROSECOND HIGH-ENERGY ELECTRON BEAM ACCELERATOR

T.M. Martin and R.S. Clark  
Sandia Labs. Albuquerque, NM 87115  
The Review Of Scientific Instruments, Vol. 47, No. 4, pp 460-463 (04/1976)

Electron beams delivering up to 60 kA at 1.5 MV with pulse durations of 0.5-1.5 microseconds were obtained by connecting a low-inductance Marx generator directly across a vacuum diode. Beams with up to 44 kJ and conversion efficiencies up to 51% from Marx energy into electron beam energy were obtained. 11 Refs.

Primary Keywords: Marx Generator; Field Emission Diode; 1.5 Microsecond Pulse Length; No Intermediate In Store  
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# 311 (PULSE GENERATORS)

(Capacitor Banks)  
AN INEXPENSIVE PULSED POWER SUPPLY FOR A SEPTUM MAGNET

W.F. Praeg  
Argonne National Lab. Argonne, IL  
IEEE Transactions On Nuclear Science, Vol. NS-22, No. 3, pp 1307-1310 (06/1975)

A 16 microhenry, 6 milliohm septum magnet load must be pulsed while extracting beam from the 200 MeV booster of the Zero Gradient Synchrotron (ZGS). A power supply was designed for this purpose that can deliver approximately 2 ms wide, half sine wave pulsed with a PRF of 30 pulses per second. The peak current is adjustable from 3 kA to 13 kA and repeatable within  $\pm 0.05\%$  by means of a novel charging circuit. By providing a transformer between the magnet and the capacitor bank, the overall cost of the system was reduced to less than one half of that of a conventional capacitor discharge system. A high-Q choke shunts the negative half wave of the current around the transformer, thereby extending the life expectancy of the magnet and increasing the circuit efficiency. 3 Refs.

Primary Keywords: Capacitor Bank; Step-down Transformer; Half-sinusoidal Waveform; Inductive Load; Rep-rated  
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# 317 (PULSE GENERATORS; POWER CONDITIONING)

(Line Type; Saturable Reactors)  
GENERATOR PRODUCING NANOSECOND PULSES WITH AN INCREASED REPETITION FREQUENCY

I.G. Ketehev and I.I. Rozhkov  
Gorkii Polytechnic Institute, USSR  
Instruments And Experimental Techniques, Vol. 17, No. 4, pp 1037-1038 (08/1974).

Trans. From: Priory i Tekhnika Eksperimenta 4, 88-89 (July-August 1974)

A generator is described which produces rectangular nanosecond pulses and is designed for operation into an arbitrary load. The principle of contraction of electromagnetic energy and the formation of electromagnetic shock waves in transmission lines with ferrite is used in the generator. The power of the output pulses is 3 kW, and the maximum repetition frequency is 25 kHz. 4 Refs.

Primary Keywords: Rectangular Pulse; Thyatron; Ferrite; Electromagnetic Shock Wave; 3 kW Output Power; Rep-rated  
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# 323 (INSULATION, MATERIAL)

(Solid)  
THE RESEARCH IN DISCHARGE SUPPRESSION OF HIGH VOLTAGE CROSSLINKED POLYETHYLENE INSULATED POWER CABLE

S. Fujiki, H. Furushawa, T. Kuhara and M. Matsuba  
The Furukawa Electric Co. Ltd., Tokyo, Japan  
IEEE Transactions On Power Apparatus And Systems, Vol. PA5-90, No. 6, pp 2703-2709 (12/1971).

The main reason why high voltage plastic power cables lead to the dielectric breakdown is considered the insulation deterioration which is brought about by partial discharges within voids and other anomalies. We have taken various measures in order to suppress these partial discharges. Then we got an idea that when some semi-conductive organic material is blended in the insulation material, the surface resistivity of voids in the insulation and between the insulation and semi-conductive layer is reduced. Our study based on this idea produced effectual results. This paper describes the theoretical analysis, fundamental experiments and application experiments to cables and cable joints. 4 Refs.

Primary Keywords: Crosslinked Polyethylene; Partial Discharge; Insulation Deterioration; Semi-conductive Organic Material  
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# 327 (PULSE GENERATORS; POWER CONDITIONING)

(Capacitive; Pulse Transformers)  
A NOMINAL ONE-MEGAVOLT, PULSED POWER GENERATOR

T.H. Martin  
Sandia Labs. Albuquerque, NM 87115  
IEEE Transactions On Nuclear Science, Vol. NS-18, No. 3, pp 104-105 (03/1971).

A pulsed voltage generator, called Frizz, has been designed and constructed at Sandia Laboratories and is now being used as a voltage source for breakdown studies of various materials. Frizz generates a nominal 100 ns pulse of variable rise time from 5 to 50 ns across a vacuum chamber in which dielectric test samples are placed. 4 Refs.

Primary Keywords: Variable Rise Time; Series Inductor; Spark Gap; Capacitor Energy Store; Pulse Transformer  
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# 333 (BREAKDOWN STUDIES)

(Gas; Optical)  
OPTICAL BREAKDOWN OF COMPRESSED GASES BY CO/SUB 2 LASER RADIATION

N.G. Basov, E.M. Selenov, V.A. Danilychev, O.M. Kerimov and I. B. Kovsh  
F.N. Lobachev Physics Institute, Academy of Sciences of the USSR, Moscow, USSR  
Soviet Physics JETP, Vol. 36, No. 6, pp 1061-1063 (06/1973).

Trans. From: Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki 63, 2010-2014 (December 1972)

The breakdown of compressed gases by CO/sub 2/ laser radiation was investigated theoretically and experimentally. The high-pressure breakdown ( $P \geq 30$  atm) differed considerably from the breakdown in low-pressure gases: the threshold flux density and the energy of the radiation, which were decreasing functions of  $p$  at low pressures, increased with  $p$  at high pressures. The pressure dependences of the threshold density and energy of the radiation were different for molecular and atomic gases. 10 Refs.

Primary Keywords: Volume Breakdown; Several Gases; 30 atm Pressure Range; Molecular Gas; Atomic Gas; Experiment; Theory  
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334  
(PULSE GENERATORS: POWER CONDITIONING)  
(Reviews: Pulse Forming Lines)  
PULSED POWER GENERATORS

L.S. Levine and M.G. Ury  
Naval Research Lab, Washington, DC 20375  
IEEE Transactions On Nuclear Science, Vol. NS-20, No. 1, pp 456-462  
(02/1973).  
Pulsed power generators are capable of delivering as much as megajoules of energy in pulses of 100 nsec or less. A brief review of the technological approach to this problem is presented as well as the description of three different devices: Gemble II, AURORA, and a small laboratory device designed at NRL. 21 Refs.  
Primary Keywords: Review; Marx Generator; L-C Generator; Blumlein Line; Pulse Forming Line; Gemble II; AURORA  
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335  
(PARTICLE BEAMS, ELECTRON; PULSE GENERATORS)  
(Generation: Reviews)  
PULSED POWER TECHNOLOGY FOR CONTROLLED THERMONUCLEAR FUSION  
L.S. Levine and I.M. Vitkovitsky  
Naval Research Lab, Washington, DC 20375  
IEEE Transactions On Nuclear Science, Vol. NS-18, No. 4, pp 255-264  
(04/1971).

Over the past few years, the technology of pulsed power generators has been developed to the level where it is possible to produce powers on the order of  $10^{12}$  W for times on the order of  $10^{-7}$  sec. Such generators are most commonly utilized to produce intense relativistic electron beams, and this paper briefly surveys the existing state of the art of generators and relativistic beams. As examples, recent work at NRL is considered in some detail. Finally, several potential applications of this technology in controlled fusion research will be discussed. 38 Refs.  
Primary Keywords: Relativistic E-beam; Review; Marx Generator; Pulse Forming Line; Field Emission Diode; Drift Tube  
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336  
(PULSE GENERATORS: ENERGY STORAGE, CAPACITIVE)  
(Capacitor Bank; Capacitor Bank)  
PULSE GENERATOR PRODUCING A HIGH-POWER CURRENT  
A.M. Andrianov, V.F. Demichev, G.A. Eliseev, P.A. Levit, A.Yu. Sokolov and A.K. Terent'ev  
Instruments And Experimental Techniques, Vol. 14, No. 1, pp 124-126  
(02/1971).  
Trans. From: Pribury i Tekhnika Eksperimenta 1, 112-114  
(January-February 1971).  
A capacitor bank made up of 16 low-inductance KMK-30-8 capacitors is described. For a comparatively low energy capacity of 58 kJ the bank has an intrinsic oscillatory pulse power of  $1.4 \times 10^{11}$  W and a short-circuit current of 3.5 MA. Low-inductance vacuum spark gaps serve as the current commutators. 5 Refs.  
Primary Keywords: Capacitor Bank; 58 kJ Stored Energy;  $10^{11}$  W Output; 3.5 MA Short Circuit Current; Vacuum Spark Gap; Low Inductance  
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339  
(SWITCHES, OPENING)  
(Plasma Erosion)  
PLASMA EROSION SWITCHES WITH IMPLoding PLASMA LOADS ON A MULTITERAWATT PULSED POWER GENERATOR  
R. Stringfield, R. Schneider, R.D. Genuario, I. Roth, K. Childers, C. Stallings and D. Dakin  
Physic International Co, San Leandro, CA 94577  
Journal Of Applied Physics, Vol. 52, No. 3, pp 1278-1284 (03/1981).  
Plasma erosion switches have been fielded on the PITHON generator during imploding plasma experiments. Theta pinch plasma guns were used to inject carbon plasmas of densities in the range of  $10^{12} - 10^{14}$  cu.cm. between the electrodes of the vacuum or feed region, upstream from an imploding plasma load. Current monitors indicated that the erosion switches carried substantial current early in time, diverting it from the load. Late in the pulse the erosion switches opened, transferring the current to an imploding plasma with the effect of sharpening the current rise time at the load. Associated with the sharper rise time was an improvement in the quality of the plasma implusions. The results of varying the density and total number of particles in the plasma of the switches are presented with regard to the effect on the current along the vacuum feed and on the behavior of vacuum flowing electrons. 5 Refs.  
Primary Keywords: Plasma Erosion Switch; Opening Switch; PITHON; Fast-rise; Experiment; Theory; Plasma Density Dependence  
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351  
(PULSE GENERATORS)  
(Line Type)  
HIGH-VOLTAGE PULSE GENERATOR FOR WIRE SPARK CHAMBERS  
Y.D. Karpakov, G.P. Makarov, Y.N. Simonov and V.P. Sugonyayev  
GIAE Atomic Energy Institute, Moscow, USSR  
(01/1975).  
Availability: IFVE-PEF-75-130  
NTIS

A HV pulse generator for power supply of wire spark chambers with pulsed hydrogen thyratron and discharge line in the end cascade is described. The generator forms the pulses of negative polarity with the rise time of 30 nsec, with 170 nsec duration, stabilized pulse-height that may be changed within the limits from 4 up to 6 kV and time delay of about 100 nsec with respect to the triggering signal. (Atomindex citation 09:361077)  
Primary Keywords: High-voltage Pulse Generators; Wire Spark Chambers; Delay Circuits; Design; Pulse Rise Time; Pulse Shapers; Tables; Thyratrons; Timing Properties  
Secondary Keywords: IN RUSKIAN, ERDA/440104; USSR, NTIS/NTIS  
Distribution Restriction: U.S. SALES ONLY.

378  
(PARTICLE BEAMS, ELECTRON; BREAKDOWN STUDIES)  
(Generation: Vacuum, Electrical)  
ELECTRON BEAM GUN SIMULATION  
T.E. Springer and W.J. Sarjeant  
Los Alamos National Labs, Los Alamos, NM 87545  
LASL Report No. E-DO-740-80 (01/1981).  
Availability: E-DO-740-80  
LASL

A numerical simulation of a small, hot-cathode electron beam gun is presented. Since the time required for the electric field to propagate into the structure is short compared to the pulse widths of interest (a few nanoseconds compared to 5-200 microsecond pulse widths), electrostatic field and potential calculations are made and space charge is ignored. Calculated E-field and potential plots are shown, along with equipotential and electron trajectory diagrams. Agreement with experiment is good. Suggestions are presented for improving beam uniformity and increasing breakdown potential in similar devices. 2 Refs.  
Primary Keywords: Hot Cathode; Long Pulses; Simulation; Fields Plots; Electron Trajectories; Laplace's Equation  
Secondary Keywords: Laser Pumping; Continuous Cathode Voltage

392  
(INSULATION, MATERIAL; BREAKDOWN STUDIES)  
(Gas; Gas, Electrical)  
A CIRCUIT WHICH PREDICTS AND DIVERTS FLASHOVER FROM A LONG AIR GAP  
G. Jarvis-Hunter  
Marchwood Engineering Lab, Southampton, UK  
The Review Of Scientific Instruments, Vol. 45, No. 3, pp 403-405  
(03/1974).

A fast, rugged, electronic circuit is described which predicts an impending switching surge flashover in a long air gap and diverts the discharge energy into a triggered bypass gap. Prediction is based on the amount of charge injected into the gap by the high voltage electrode. A protective gap could be designed which would operate only if the insulation being protected were about to fail. This could significantly improve the techniques of insulation coordination and has important implications for studies of the mechanisms of the long spark. 2 Refs.  
Primary Keywords: Air Gap; Self-breakdown; Bypass Gap; Displacement Current; Corona Current; Current Detection; Breakdown Prevention  
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393  
(PULSE GENERATORS)  
(Systems)  
A GENERATOR FOR STARTING ACOUSTIC CHAMBERS  
V.N. Afanas'ev, O.N. Kryzhanovskii, P.I. Lebedev, V.I. Orlovichikov and Yu.F. Tomashchuk  
Institute Of Theoretical And Experimental Physics, Moscow, USSR  
Instruments And Experimental Techniques, Vol. 16, No. 5, pp 1427-1429  
(10/1973).  
Trans. From: Pribury i Tekhnika Eksperimenta 5, 111-114  
(September-October 1973).

A generator is described for starting acoustic chambers using a TG11-1000/25 thyratron as the commutating element. The overall delay of the circuit is approximately equal to 140 nsec; the maximum operating frequency, which is determined by the high-voltage rectifiers, is approximately equal to 50 Hz. 3 Refs.  
Primary Keywords: Delay Generation; 5 kV Operating Voltage; Thyratron; Rectifier  
Secondary Keywords: Acoustic Spark Chamber  
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394  
(SWITCHES, CLOSING)  
(Thyratrons)  
A MULTIGAP, DOUBLE-ENDED, HYDROGEN THYRATRON  
M. Menoun and B.P. Newton  
English Electric Valve Co Ltd, Chelmsford, Essex, UK  
IEEE 1973 Eleventh Modulator Symposium pp. 232-235 (09/1973).

This paper discusses the limitations of conventional ceramic thyratrons with regard to inverse voltage and describes a double-ended, multigap thyratron capable of conduction in both directions. This new device behaves as a triggered, bidirectional switch and so improves commutation and simplifies circuit design. Methods of triggering, excitation and protection are described. 8 Refs.  
Primary Keywords: Multigap Thyratron; Double-ended Thyratron; Conduction In Both Directions  
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398  
(ENERGY STORAGE)  
(Reviews)  
CONTEMPORARY CAPACITIVE ENERGY STORAGE SYSTEMS  
E.L. Kemp  
Los Alamos National Labs, Los Alamos, NM 87545  
IEEE Transactions On Nuclear Science, Vol. NS-20, No. 1, pp 446-451  
(02/1973).

Capacitive energy storage is one of the oldest forms of energy storage for pulsed power requirements. Most energy storage capacitors are made of Kraft paper and aluminum foil and impregnated with castor oil. A typical capacitor stores approximately 3000 joules at voltage ratings of 5 kV-100 kV. Two types of switches are used for capacitor bank switching, ignitrons and pressurized spark gaps. Ignitrons are commercially available, have a wide voltage operating range and are easy to trigger. However, they are limited to approximately 20 kV for most applications and they will prefire. Spark gaps can be designed for reliable operation at almost any voltage level but they are rarely commercially available. Most spark gaps do not operate satisfactorily below 50% of their design voltage and they require a more complicated trigger system than ignitrons. Low inductance coaxial cable has been developed for capacitor bank transmission systems. It is relatively inexpensive and commercially available. Parallel plate transmission lines can be designed to accumulate large amounts of current and conduct it to a concentrated load but careful attention must be given to the containment of the magnetic forces involved. 9 Refs.  
Primary Keywords: Capacitor; Ignitron; Spark Gap; Coaxial Cable; Strip Line  
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- 399  
(PULSE GENERATORS)  
(Reviews)  
DESIGN CONSIDERATIONS FOR SUPER POWER PULSE MODULATORS  
D.L. Pruitt  
RCA Corp, Moorestown, NJ 08057  
IEEE 1973 Eleventh Modulator Symposium (09/1973).  
Design criteria are discussed which are particularly pertinent to super power artificial line-type modulators. A sample design is illustrated which uses 60 hydrogen thyratron switch tubes in 30 unit modulators to supply 2.5 gigawatts peak power and 18 megawatts average power. A concept physical layout is shown for the sample design. 0 Refs.  
Primary Keywords: Line-type Modulator; Design Considerations; Super Power; Thyratron; Spark Gap; End-of-line Clipper; Pulse Transformer; Charging Network  
COPYRIGHT: 1973 IEEE. REPRINTED WITH PERMISSION
- 402  
(PARTICLE BEAMS, ION)  
(Generation)  
PULSED ION DIODE EXPERIMENT  
D.S. Prono, J.W. Shearer and R.J. Briggs  
Lawrence Livermore Lab, Livermore, CA 94550  
Physical Review Letters, Vol. 37, No. 1, pp 21-25 (07/1976).  
Experiments in ion generation with a reflex-diode are presented. The DUL II generator is used to generate ion beams with total ion current up to 150 kA. Two modes of operation were seen. The first 50 nsec of operation are as a normal diode, then the impedance drops (accompanied by ion flow). An explanation is given for this behavior. 12 Refs.  
Primary Keywords: Ion Diode; 300 kV Voltage Range; Reflex-triode; Experiment; Theory; Magnetic Stabilization; Several Anode Foils  
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- 403  
(PULSE GENERATORS; SWITCHES, CLOSING; POWER CONDITIONING)  
(LC; Thyratrons; Pulse Forming Networks)  
GENERATION OF HIGH CURRENT, LONG DURATION RECTANGULAR PULSES  
P.E. Faugeras, H. Kuhn and J.P. Zenasco  
CERN, Preessin, France  
IEEE 1973 Eleventh Modulator Symposium pp. 23-28 (09/1973).  
The excitation of the fast pulsed kicker magnets foreseen for the CERN 400 GeV proton synchrotron requires rectangular pulses with a current amplitude of 3000 A to 10000 A, a pulse duration adjustable between 1 and 24 microseconds, and short rise and fall times. These pulses are generated by a LC ladder network discharged with fast switches. Several kinds of switches have been tested: Multigap thyratrons of standard design, a composite switch called thyragitron and made of a normal thyratron by-passed by ignitrons, and finally special thyratrons with a second cathode assembly in place of the usual anode. Experimental pulse shapes and results of life tests for these different switches are presented and discussed. 8 Refs.  
Primary Keywords: LC Generator; Multigap Ignitron; Thyratron; Thyragitron; Life Test; PFM  
Secondary Keywords: Proton Synchrotron  
COPYRIGHT: 1973 IEEE. REPRINTED WITH PERMISSION
- 413  
(ENERGY STORAGE, CAPACITIVE)  
(Capacitors)  
VOLTAGE INDUCED CAPACITANCE FLUCTUATIONS IN A COMPRESSED GAS, HIGH VOLTAGE CAPACITOR  
J. Rungis and D.E. Brown  
National Measurement Lab, Sydney, Australia  
Journal of Physics E: Scientific Instruments, Vol. 8, pp 16-17 (01/1975).  
Capacitance fluctuations of the order of a few parts/million have been observed in a 335 kV capacitor after operating at 300 kV for 30 min. It has been concluded that the capacitance fluctuations are due to convection of the compressed CO/sub 2/ gas, caused by dielectric heating of the insulating walls. 0 Refs.  
Primary Keywords: Compressed Gas Capacitor; CO/sub 2/ Dielectric; Guard Electrode; Capacitance Fluctuation; 300 kV Voltage Range  
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- 414  
(SWITCHES, CLOSING)  
(Thyratrons)  
THE DISCHARGE CURRENT DISTRIBUTION OVER THE SURFACE OF THE ELECTRODES OF A HYDROGEN THYRATRON DURING A PULSE  
A.M. Iskov'skiy, Yu.E. Nesterikhin, L.B. Rukovich, V.I. Sekerin and T.B. Fogel'son  
Radio Engineering And Electronic Physics, Vol. 17, No. 6, pp 998-1002 (06/1971).  
Experiments were performed in which the current distribution over electrode surfaces in a hydrogen thyratron was examined. Pulses applied to the device lasted 30 microseconds with current varying from 200 to 2400 A. High-speed photography was used to note that the current at the anode formed a filament which rotated around the tube during the pulse. Current at the cathode did not change during the pulse. Hydrogen pressure was also varied during the tests. 8 Refs.  
Primary Keywords: Thyratron; High-power; Nonuniform Current Distribution; Grid Distribution; Anode Distribution; Moving Current Filament; Current Variation; Pressure Variation  
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- 417  
(SWITCHES, CLOSING)  
(Thyratrons)  
THE USE OF HYDROGEN THYRATRONS AS HIGH SPEED, HIGH VOLTAGE RECTIFIERS  
M. Menoun and G.J. Scoles  
English Electric Valve Co Ltd, Chelmsford, Essex, UK  
IEEE 1973 Eleventh Modulator Symposium pp. 236-238 (09/1973).  
The necessity for a high forward current, fast reverse recovery diode arose during the design of a thyratron test modulator. This paper describes how such a diode can be obtained by the use of hydrogen thyratrons in a parallel assembly. 0 Refs.  
Primary Keywords: High-voltage Rectifier; Hydrogen Thyratron; High Current; Very Fast Switching  
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- 418  
(PULSE GENERATORS)  
(Line Type)  
THYRATRON GENERATOR THAT PRODUCES RECTANGULAR PULSES HAVING A SMOOTHLY CONTROLLABLE LENGTH  
R.S. Tabachnik  
Instruments And Experimental Techniques, Vol. 16, No. 4, pp 1124-1126 (08/1973).  
Trans. From: Priroda i Tekhnika Eksperimenta 4, 120-122 (July-August 1973).  
The circuit of a powerful generator producing rectangular pulses is described which is implemented using pulsed hydrogen thyratrons with partial discharge of a storage capacitor. The circuit allows rectangular pulses to be obtained having a leading edge duration of approximately 0.1 microsec for output currents of up to tens of amperes and voltages of up to several kilovolts and allows smooth control of the pulse length from several microseconds to several milliseconds. 4 Refs.  
Primary Keywords: Rectangular Pulse; Thyratron; Microsecond-millisecond Pulse Duration; Capacitor Bank; Pulse Shaping  
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- 419  
(PULSE GENERATORS)  
(Capacitive)  
THYRATRON GENERATOR WHICH PRODUCES HIGH-VOLTAGE LONG PULSES FOR HIGH-OMH LOADS  
L.Z. Gopolitsyn and A.V. Senik  
Leningrad Electric Engineering Institute, USSR  
Instruments And Experimental Techniques, Vol. 15, No. 5, pp 1397-1398 (10/1972).  
Trans. From: Priroda i Tekhnika Eksperimenta 5, 97-98 (September-October 1972).  
A thyratron generator which shapes rectangular pulses having an amplitude of up to 20 kV across a high-ohm load of 1E4 to 1E6 ohm is described. The length of the pulse is controlled smoothly in the range from 20 to 2000 microsec. The duration of the leading and trailing edges is 1 microsec. 1 Refs.  
Primary Keywords: Capacitor Pulse Generator; Megohm-load Impedance; 20 kV Output; 20-2000 Microsecond Pulse Duration; Rectangular Pulse  
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- 424  
(PULSE GENERATORS; SWITCHES, CLOSING)  
(Reviews; Thyratrons)  
VERY HIGH FREQUENCY PULSE GENERATORS USING HYDROGEN THYRATRONS  
B.P. Meuton and G.J. Scoles  
English Electric Valve Co Ltd, Chelmsford, Essex, UK  
IEEE 1973 Eleventh Modulator Symposium pp. 162-166 (09/1973).  
Two circuits are described which have been developed to provide high voltage pulses at repetition rates up to 200 kHz. Mention is made of fast recovery hydrogen thyratrons capable of operating in these circuits. 0 Refs.  
Primary Keywords: Design Considerations; Thyratron; Very High Repetition Rate; Break Modulator Pulse Transformer  
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- 428  
(POWER CONDITIONING)  
(Pulse Forming Lines)  
A FAST HIGH VOLTAGE PULSE GENERATOR  
J.W. Jack and T. Smith  
University of Aberdeen  
Journal Of Physics E: Scientific Instruments, Vol. 6, pp 17-19 (01/1973).  
This note describes a fast high voltage pulse generator using a thyratron switch and coaxial pulse forming line. It is capable of producing a pulse with an amplitude of up to 4 kV for a duration of 40 ns and is suitable for continuous operation over periods of several hundred hours at a repetition rate of 50 Hz. 12 Refs.  
Primary Keywords: Parallel Coaxial Cables; Low Impedance; Fast Rise Time; 4 kV Output Voltage; Thyratron  
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- 429  
(PULSE GENERATORS)  
(Capacitive)  
A HIGH-VOLTAGE PULSE GENERATOR FOR SPARK CHAMBERS IN SPACE  
A. Beldin, T. Lund and R. Maday  
Kent State University, Kent, OH 44242  
Nuclear Instruments And Methods, Vol. 101, No. 2, pp 363-374 (06/1972).  
The design and performance characteristics of a high-voltage pulse generator for use with spark chambers in space are described. In order to minimize power consumption, the pulse generator is designed around a cold-cathode thyratron. The complete pulse generator consists of a thyratron pulser and an avalanche-transistor switching circuit. Included also is a simple means for applying a steady clearing field to the spark chambers. The pulse generator can be triggered at uniform repetition rates up to about 100 per second to produce negative pulses with a peak amplitude of typically 2 kV. The observed rise-time is about 5 ns with only stray capacitance loading. It increases with the capacitance loading introduced by a spark-chamber at the output of the pulser. The total delay-time from the input trigger pulse to the output pulse is about 148 ns. The pulse decays exponentially with a time constant of the order of a microsecond. Pulse amplitudes up to 4 kV are possible with the particular thyratron selected for this application. 6 Refs.  
Primary Keywords: Krypton; Capacitor; Low Energy; Keep Alive  
Secondary Keywords: Spark Chamber; Space Application  
COPYRIGHT: 1972 NORTH-HOLLAND PUBLISHING CO., REPRINTED WITH PERMISSION
- 435  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Gas; Materials; Thyratrons)  
DIELECTRIC INVESTIGATION OF ELECTRIC DISCHARGES IN A MERCURY VAPOUR FILLED THYRATRON  
T.K. Bhandopadhyaya (1) and V.K. Farkya (2)  
(1) G.S. Institute of Technology and Science, Indore, India  
(2) Molkar Science College, Indore, India  
International Journal Of Electronics, Vol. 34, No. 2, pp 253-257 (02/1973).  
Experiments are presented in which the effect of frequency and discharge current on the real and imaginary components of the dielectric constant of mercury vapour in a thyratron are studied. Frequencies from 5 kHz were used with discharge currents up to 2 mA. For low discharge currents an area of dispersion of the imaginary portion of the dielectric appears at 120 kHz due probably to a relaxation of the dipoles. 7 Refs.  
Primary Keywords: Thyratron; Mercury Vapour; Plasma; Dielectric Constant; High Frequency  
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438  
(POWER CONDITIONING; PARTICLE BEAMS, ION)  
(Systems; Generation)  
FORMATION OF COMPLEX MAGNETIC CYCLES IN A 7-GEV PROTON SYNCHROTRON  
I. F. Kleosov and G. I. Kugoshev  
Institute Of Theoretical And Experimental Physics, Moscow, USSR  
Instruments And Experimental Techniques, Vol. 14, No. 1, pp 12-17  
(02/1971).  
Trans. From: Pribury i Tekhnika Eksperimenta 1, 19-24  
(January-February 1971).  
The principles of designing universal systems for controlling  
ignitron converters are described. Systems are designed for  
successive formation of main magnetic cycles with one or two smooth  
transitions from positive values of the field derivative  $dH/dt = 4$  to  
9 kOe/sec to any stipulated value  $dH/dt < 20$  (for slow guiding of the  
beam onto the target), as well as abridged triangular cycles for  
extraction of a proton beam having an energy of approximately 200 MeV  
in the interval between the main cycles. The procedure of forming  
such cycles is demonstrated for operations of the power-supply system  
of a ring magnet in a mode of 30 cycles/min. 2 Refs.  
Primary Keywords: Ignitron; Semiconductor Switch; Voltage Feedback;  
 $dH/dt$  Feedback; Continuous Waveform  
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444  
(PULSE GENERATORS)  
(Pulse Forming Lines)  
SHORT-CURRENT-PULSE GENERATOR FOR SUPPLYING SEMICONDUCTOR LASERS  
A. I. Andrushko  
Kazan State University, Kazan, USSR  
Instruments And Experimental Techniques, No. 4, pp 1085-1087 (08/1971).  
Trans. From: Pribury i Tekhnika Eksperimenta 4, 121-122 (July-August  
1971).  
The paper describes the circuit of a generator which produces  
short rectangular current pulses for supplying lasers. The circuit  
uses the method of shaping powerful current pulses by means of a  
discharge in a vacuum tube. The operating element of the circuit is a  
thyatron. The duration of the leading edge of the pulse is 2-3  
nsec for a pulse length of approximately 240 nsec. A matching  
transformer based on cable sections, which allows the voltage to be  
stepped down and the current to be increased in the load, is used for  
powerful matching purposes. The current amplitude is equal to 50 A  
across an equivalent load of 0.2 ohm. 6 Refs.  
Primary Keywords: Transmission Line Pulsar; Thyatron; Pulse  
Transformer; Low Voltage; Low Current  
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445  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Gas, Electrical; Thyatrons)  
SOME OBSERVATIONS ON ARC POTENTIALS IN HYDROGEN THYRATRON PULSE  
DISCHARGES  
R. J. Armstrong  
Auroral Observatory, Tromsø, Norway  
Canadian Journal Of Physics, Vol. 50, No. 12, pp 1337-1345 (04/1972).  
Experiments are described in which variations in the arc voltage  
of high power hydrogen thyatrons due to changes in pulse length,  
probe voltage, and cathode temperature are examined. Light intensity  
changes in a long pulse were also noted. The current amplitude was found to  
be higher when the thyatron was pulsed when a DC voltage was  
applied. Experimental results were found to agree closely with  
calculations based on the relaxation properties of charged particles  
in a plasma. 22 Refs.  
Primary Keywords: Arc Potential; High Power; Discharge Relaxation;  
Hydrogen; Deuterium; Post-pulse Period  
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449  
(SWITCHES, CLOSING)  
(Ignitrons)  
2X II 10-MEGAJoule IGNITRON CROWBAR  
F. B. Heady  
Lawrence Livermore Lab, Livermore, CA 94550  
IEEE Transactions On Nuclear Science, Vol. NS-18, No. 4, pp 322-330  
(04/1971).  
A 10-MJ Ignitron Crowbar Array for the 2X II fusion machine has  
been installed, and is now in operation. It is designed to handle  
about three times the energy of the previous array used with the 2X  
machine, which has been supplanted by the 2X II. In addition, this  
array is expected to be considerably more reliable than previous  
designs. Furthermore, the floor utilization of the assembly is  
considerably improved, access to all components is better, and the  
overall cost per kilojoule is substantially reduced. Two insulated  
identical main pulse coils are incorporated in the 2XII machine.  
Similarly, the crowbar array is split into two equal parts, with each  
connected permanently across its pulse coil. 1 Refs.  
Primary Keywords: Ignitron; Crowbar; Design Considerations; Pulse  
Extension  
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453  
(PULSE GENERATORS)  
(Capacitive)  
A DOUBLE-TUNED CURRENT GENERATOR WITH ELECTRONIC AMPLITUDE CONTROL  
L. A. Kalina, P. A. Movshay and I. B. Pavlova  
Instruments And Experimental Techniques, Vol. 17, No. 3, pp 742-744  
(06/1974).  
Trans. From: Pribury i Tekhnika Eksperimenta 3, 104-106 (May-June 1974).  
A pulse-current generator (p.c.g.) producing pulses having a  
length of 120 microseconds and a half-sinusoid shape in an inductive  
load at a pulse energy of 30 J is described which contains two  
controlled thyristor switches: one switch in the charging circuit  
controls the amplitude, while the other in the discharge circuit  
controls the phase of the current pulse in the load. Special  
attention is devoted to the linear and nonlinear elements in the  
power and control circuits of the thyristor columns; these elements  
ease the dynamic mode of the thyristors. Experimental data are  
presented for the p.c.g. 14 Refs.  
Primary Keywords: Current-pulse Generator; 1250 A Output Current;  
Half-sinusoid Output; Thyristor  
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466  
(SWITCHES, CLOSING)  
(Ignitrons)  
ROLE OF SILICON CARBIDE/MERCURY INTERFACE IN IGNITRONS  
M. J. Zarabi and M. Sanyal  
Indian Institute of Science, Bangalore, India  
Journal Of Physics D: Applied Physics, Vol. 3, No. 8, pp 1284-1289  
(08/1970).  
A new model of ignition in an ignitron, based on the electrical  
breakdown of the junction between the ignitor (semiconductor) and the  
mercury (metal) is proposed. A method of evaluating some of the  
ignition characteristics is also developed. The paper gives a  
critical summary of the various characteristics of the ignition  
process. The new model is stated and used to explain all the ignition  
characteristics. The experiments conducted in support of the various  
aspects of this model are also given. 10 Refs.  
Primary Keywords: Breakdown Characteristics; Modeling; Ignition Of  
Discharge; Junction Breakdown  
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467  
(BREAKDOWN STUDIES; DIAGNOSTICS AND INSTRUMENTATION)  
(Gas, Electrical; Miscellaneous)  
SPHERICAL PROBE IN A FLOWING PLASMA  
J. G. Andrews and D. T. Swift-Hook  
Marchwood Engineering Lab, Southampton, UK  
Journal Of Physics A: General Physics, Vol. 4, No. 1, pp 142-157  
(01/1971).  
Ion flow is important in many laboratory discharges, vacuum  
switches, gas-filled valves, thyatrons and space satellites. A model  
is presented for subsonic ion flow past a negative spherical probe  
immersed in a collisionless ionization-free plasma: a stagnation  
point develops downstream. Although the floating potential given by  
previous analyses (which all assume spherical symmetry) is  
substantially correct, there is some dependence on the ion flow  
velocity (a few % at  $M \approx 0.5$ ). Thus the change in floating potential  
can be used to measure ion flow. In general, only slight modification  
needs to be made to low pressure probe theories in order to include  
flow effects. 19 Refs.  
Primary Keywords: Subsonic Ion Flow; Spherical Probe; Effect On Flow;  
Modeling; Potential Measurement  
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468  
(SWITCHES, CLOSING; PULSE GENERATORS)  
(Capacitive)  
SQUARE PULSE GENERATOR WITH PULSES OF LARGE AMPLITUDE AND OF VARYING  
DURATION AND FREQUENCY  
D. M. Timush  
Institute Of Atomic Physics, Bucharest, Rumania  
Instruments And Experimental Techniques, No. 3, pp 811-816 (06/1970).  
Trans. From: Pribury i Tekhnika Eksperimenta 3, 156-161 (May-June 1970).  
A comparative analysis of series and parallel circuits for  
connecting thyatrons in pulse generators shows that the parallel  
circuit has definite advantages. There is a brief description of a  
generator built on the basis of such a circuit which gives pulses  
with an amplitude up to 10 kV, a repetition frequency of 5-400 cps,  
and a duration of 5-300 microseconds. 5 Refs.  
Primary Keywords: Thyatron; Series Operation; Parallel Operation;  
Pulse Shaping  
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477  
(PARTICLE BEAMS)  
(Miscellaneous)  
ESTIMATES ON THE ACCELERATION OF PELLETS BY GASDYNAMIC AND  
ELECTROSTATIC MEANS  
L. L. Lengyel and W. Riedmüller  
Institut für Plasmaphysik, Garching, FRG  
IPP Report No. IPP 4/71 (07/1978).  
The authors use mathematical models to estimate the maximum  
velocity to which a hydrogen pellet could be accelerated. Using  
gasdynamic drag acceleration the maximum velocity was estimated to be  
on the order of 100 m/s, while with pneumatic acceleration and  
electrostatic acceleration velocities on the order of 1000 m/s were  
estimated to be possible. 29 Refs.  
Primary Keywords: Pellet Acceleration; Electrostatic Acceleration;  
Gasdynamic Acceleration; Pneumatic Acceleration

478  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
EXCITATION OF HIGH-PRESSURE LASER MEDIA BY A DISCHARGE THROUGH AN  
INSULATOR  
V. N. Ishchenko, V. N. Lisitsyn and A. R. Sorokin  
Institute Of Semiconductor Physics, Academy of Sciences of the USSR,  
Novosibirsk, USSR  
Sov. J. Quant. Electron., Vol. 8, No. 4, pp. 453-457 (04/1978).  
Trans. From: Kvantovaya Elektronika (Moscow) 5, 788-794 (April 1978).  
The authors report a scheme to pump high-pressure laser media by a  
discharge through an insulator. The suitability of several insulation  
materials is determined using permittivity and electrical breakdown  
strength of the insulator, and pyroceramic is found to be best for  
pulsed discharges. It is found experimentally that the E/p of the  
discharge can be varied over a wide range, which could previously  
only be done using an e-beam controlled pump. It was found that both  
carbon dioxide and atomic transition lasers could be pumped  
efficiently with this method. 7 Refs.  
Primary Keywords: Discharge Through An Insulator; Pyroceramic; Glass;  
Variation Of E/p; Pulsed Discharge  
Secondary Keywords: CO/sub 2/ Laser; Atomic Transition Laser  
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483  
(PULSE GENERATORS; SWITCHES, CLOSING)  
(Capacitive; Thyatrons)  
A CERAMIC THYRATRON WIRE SPARK CHAMBER PULSER  
B. Friend  
CERN, Geneva, Switzerland  
Nuclear Instruments And Methods, Vol. 65, No. 3, pp 311-313 (11/1968).  
A triggered high voltage pulse generator with 1800 A output  
capability has been developed for use with wire spark chambers. It  
has short delay and rise times, a high repetition rate and a long  
lifetime. 5 Refs.  
Primary Keywords: Ceramic Thyatron; Tetrode Thyatron; Coaxial  
Structure; Fast Rise Time; Low Trigger Power  
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487  
(PULSE GENERATORS; ENERGY STORAGE, INDUCTIVE)  
(Systems; Systems)  
CONVERTERS FOR SUPPLYING PULSED POWER LOADS  
M. Mohan (1) and J.T. Broach (2)  
(1) University of Minnesota, Minneapolis, MN  
(2) U.S. Army Research Office, Fort Belvoir, VA  
IEEE Transactions On Industry Applications, Vol. IA-15, No. 1, pp 85-91  
(02/1979)  
There is a growing need for supplying repetitive pulsed power loads of increasing magnitudes up to several hundred megawatts or more in areas of radar, lasers, high-energy physics experiments and thermonuclear fusion. The nature of such loads can be expected to be as diverse as their applications. The pulsed power demands and corresponding reactive volt-ampere requirements are undesirable from the frequency and voltage fluctuation standpoint, even for the large utility power systems. Techniques for supplying large DC-pulsed loads from a relatively small size AC generator by means of inductive storage and the capacitor commutated converters are presented. A theoretical basis is provided for analyzing the converters which serve to minimize the effects of pulsed power and corresponding reactive volt-amperes. Energy transfer between the storage inductor and the pulsed load is permitted with minimal loss, at a readily controllable rate including the reversibility of power in case of inductive loads. Use of a simple control scheme is shown to provide a precise load voltage regulation which may be a requirement for certain applications. The great use of these circuits would be in supplying loads with pulse durations of a few milliseconds to many seconds or minutes. 9 Refs.  
Primary Keywords: Pulse Generator; Inductive Energy Storage; Capacitor Commutator; Analysis; Long Pulse; Rep-rated  
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488  
(INSULATION, MATERIAL)  
(Solid)  
SOLID INSULATORS IN VACUUM: A REVIEW  
R. Hawley  
C.A. Parsons & Co Ltd, Newcastle-upon-Tyne, UK  
Vacuum, Vol. 18, No. 7, pp 383-390 (07/1968)  
The authors bring together the work of several researchers to present a good review of the behavior of solid insulators in vacuum. The effect of surface angle of declination, electrode and insulator material and surface conditions, length dependence, ambient pressure, coatings, and gas conditioning are all considered with qualitative results presented where available. Several suggestions are made for increasing breakdown strength of solid insulators in vacuum. A qualitative review of breakdown along an insulator in vacuum is presented. 26 Refs.  
Primary Keywords: Solid Insulator; Vacuum; Breakdown Phenomena; Prebreakdown Phenomena; Variation of Several Parameters; Increased Dielectric Strength  
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489  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
TWO-MEGAVOLT DIVIDER FOR PULSED HIGH VOLTAGES IN VACUUM  
D.G. Pellinen and M.S. Di Capua  
Physics International, San Leandro, CA  
Review Of Scientific Instruments, Vol. 51, No. 1, pp 70-73 (01/1980)  
This paper describes the development of a resistive voltage divider to measure pulsed voltages in excess of 2 MV in vacuum for approximately 100 ns. The monitor can measure either positive or negative polarity by changing the low voltage insulator and reversing the remainder of the insulators and gradient rings. 15 Refs.  
Primary Keywords: Megavolt Pulse Divider; Megavolt Vacuum Divider; High Voltage Pulse Divider; Vacuum Insulation; High Frequency Divider  
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507  
(SWITCHES, OPENING)  
(Mechanical)  
STUDY OF THE EFFECTS OF GAS FLOW ON THE PERFORMANCE OF GAS-BLAST CIRCUIT BREAKERS  
M. Kooplin, K. Roloff and N. Zuckler  
Siemens AG, Berlin, FRG  
Proceedings Of The IEEE, Vol. 59, No. 4, pp 518-524 (04/1971)  
Experiments were carried out at a Siemens laboratory with specially designed circuit breakers to investigate the relationship between gas flow and arc behavior for various shapes and arrangements of gas nozzles, as well as for different types of gas and pressure conditions. The current, post-arc current, and voltage measurements were supplemented by the employment of optical methods. By using a high-speed schlieren camera, it was possible to obtain valuable information on the flow characteristics and density of the gas surrounding the arc and to estimate the influence of these quantities on the arc-quenching capacity of a breaker. The interaction of the electric power system and the arc could also be taken into account by using a dynamic arc model. 17 Refs.  
Primary Keywords: Gas-blast Breaker; Gas Flow; Arc Behavior; Current Measurement; Post-arc Current Measurement; Voltage Measurement  
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513  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Specifications)  
HIGH VOLTAGE SPECIFICATIONS AND TESTS (AIRBORNE EQUIPMENT)  
M.G. Dunbar  
Boeing Aerospace Co, Seattle, WA 98124  
AFAPL Report No. AFAPL TR-79-204 (04/1979)  
Availability: AD A669473  
NTIS  
Design engineers rely upon system and component standards and specifications as guides for developing electrical equipment. Specifications and standards are available for most low voltage and commercial high voltage equipment, but not for high voltage/high power airborne equipment with ratings exceeding 20 kV and 20 kW. The test and specification criteria (Engineering Criteria Documents) referred to in this paper pertain to high voltage/high power airborne equipment. 0 Refs.  
Primary Keywords: Cables; Cable Assemblies; Capacitors; Connectors; High Power; High Voltage; Transformers; Partial Discharge Test Set  
Secondary Keywords: Airborne Equipment; Power Characteristics

515  
(PULSE GENERATORS; ENERGY STORAGE, CAPACITIVE)  
( Marx Generators)  
CHARACTERISTICS OF CO-AXIAL MARX GENERATOR AND ITS APPLICATION TO ELECTRON BEAM FUSION  
K. Takagi, Y. Kubota and A. Miyahara  
Nagoya University, Nagoya, Japan  
Japanese Journal Of Applied Physics, Vol. 18, No. 6, pp 1135-1141  
(06/1979)  
The design of a 720 kV co-axial Marx generator producing a pulse of 40 ns duration with a rise time of 4 ns is presented. The requirements for electron beam fusion and the role of co-axial Marx generators is discussed. Possible applications of the rectangular output pulse produced are examined. 7 Refs.  
Primary Keywords: Coaxial Marx Generator; Short Rise Time; Design Considerations  
Secondary Keywords: E-beam Fusion  
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517  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
COMPACT ELECTRON ACCELERATOR FOR PUMPING GAS LASERS  
D.V. Bunich and L.P. Brudley  
Lawrence Livermore Lab, Livermore, CA 94550  
1976 IEEE Pulsed Power Conference Proceedings, Paper ID-3 (11/1976)  
We describe the design and application of a simple e-beam generator for the repetitive pulse pumping of gas lasers. The circuit uses a low inductance Marx and series tuned pulse forming elements. 5 Refs.  
Primary Keywords: E-beam Gun; Rep-rated; Uniform Energy Density; Window Foil Lifetime  
Secondary Keywords: Gas Laser Pumping  
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538  
(PARTICLE BEAMS, ION)  
(Generation)  
MICROSECOND-PULSED ION BEAM FROM A MARX GENERATOR  
S. Robertson and M. Wickham  
University of California, Irvine, CA 92717  
IEEE Transactions Of Plasma Science, Vol. PS-7, No. 1, pp 62-64  
(03/1979)  
We have maintained Langmuir-Child bipolar flow at a peak voltage of 450 kV in a vacuum diode for 1 microsecond without gap closure or electrical breakdown of the diode insulator. An ion current of >300 A (>7.5 A/cm<sup>2</sup>) was extracted from the diode in a beam having a large component of divergence <10/sup -2/ rad. 11 Refs.  
Primary Keywords: Vacuum Diode; Langmuir-Child Bipolar Flow; Microsecond Time Scale  
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540  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
ON THE DEVELOPMENT OF A REPETITIVELY PULSED ELECTRON BEAM SYSTEM  
G.A. Tripoli  
Ion Physics Corp, Burlington, MA 01803  
2nd IEEE International Pulsed Power Conference Proceedings, pp 214-216  
(04/1979)  
A pulsed electron beam system--PEBS-III--has been developed at Ion Physics Corp. to generate an electron beam of 200 keV, 4 A/cm<sup>2</sup>, 2.5 cm X 75 cm, 1.3 microsecond, at high repetition rates. That system incorporates a gas-insulated PFN Marx generator in Guillemin C network configuration to drive a solid-cathode electron gun. System performance corresponded to computer simulation of VJ waveforms versus generator parameter and impedance-collapse variations. The effort demonstrated the usability of a PFN for energization of long-pulse repetitively pulsed electron guns. 0 Refs.  
Primary Keywords: PEBS-III; Marx Generator; Pulse Forming Network; Cathode Diode; Numerical Calculation; Experiment; Long Pulse  
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541  
(PARTICLE BEAMS, NEUTRAL)  
(Generation)  
PULSED POWER APPLICATIONS TO INTENSE NEUTRON SOURCE DEVELOPMENT  
J.J. Ramirez, A.J. Toepfer and M.J. Clauser  
Sandia Labs, Albuquerque, NM 87115  
Nuclear Instruments And Methods, Vol. 145, No. 1, pp 179-183 (08/1977)  
The use of conventional and near term pulsed power technology to generate intense fluxes of neutrons for use in fusion reactor materials studies is discussed. Two types of neutron production mechanism are considered. For the immediate future, the use of single pulse or high rate intense ion beam sources is proposed to provide high fluxes of neutrons from beam-target interactions. Further along in time, the use of intense ion or electron beams to initiate inertially confined fusion reactions will lead to intense sources of thermonuclear neutrons. 24 Refs.  
Primary Keywords: Neutral Beam; Ion Beam; E-beam; Magnetic Insulation  
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545  
(INSULATION, MATERIAL)  
(Solid)  
VERSATILE THREE-TERMINAL CELL FOR INVESTIGATING THE ELECTRICAL PROPERTIES OF INSULATING MATERIALS OVER A WIDE FREQUENCY AND TEMPERATURE RANGE  
F. Sandrolini  
Universita di Bologna, Bologna, Italy  
Journal Of Physics F: Scientific Instruments, Vol. 13, No. 2, pp 152-154 (02/1980)  
A three-terminal cell for the measurement of conductivity and dielectric permittivity of insulating materials (chiefly polymers) over a wide range of frequency (DC to 0.6 MHz) and temperature (140-650 Deg K) in various environments (from vacuum to some pressure of a desired gas) is described. Heat is transferred by conduction from a cooling/heating unit in contact with the high-voltage electrode. The measuring electrode is insulated by a silica glass washer of very high purity and resistivity. Performances are described and discussed. 19 Refs.  
Primary Keywords: Insulation Characterization; Conductivity; Permittivity; Wide Frequency Range; Wide Temperature Range; Design Considerations  
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546  
(POWER CONDITIONING)  
(Pulse Transformers, Materials)  
FERRITES FOR LINEAR APPLICATIONS I-PROPERTIES

E.C. Snelling  
Mullard Research Labs  
IEEE Spectrum, Vol. 9, No. 1, pp 42-51 (01/1972).  
This two part tutorial article describes properties and applications of magnetically soft ferrites. These materials, which are characterized by high permeability and low losses, are used in very large quantities as cores for inductors and transformers. This first installment provides an elementary introduction to the processes of magnetization in ferrites. It also includes a survey of available grades and a summary of the technical properties of typical modern ferrites. Part II, to appear in February, reviews the main applications, describing how the material properties and performance requirements come together in the design of the device. 16 Refs.  
Primary Keywords: Magnetization; Soft Ferrite; Ferrite Grades; Basic Theory; Grain Boundary

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550  
(ENERGY STORAGE, CAPACITIVE; PULSE GENERATORS)  
(Marx Generators; Marx)

300-KJ, 200-KA MARX MODULE FOR ANTARES  
K.B. Rippe, J. Bickford, J. Jansen and W. Turner  
Los Alamos National Labs, Los Alamos, NM 87545  
2-3 IEEE International Pulsed Power Conference Proceedings, pp 254-260 (06/1979).

Antares is a 100-KJ CO/sub 2/ laser driver for inertial confinement fusion experiments. The power amplification stage is pumped by an electron-beam-controlled gas discharge. There are 24 annular discharge regions each requiring energy input of 250 kJ at 550 kV, in a 2-microsecond pulse. The energy storage module chosen for this system is a single-marx pulse-forming network. To provide sufficient energy margin each module stores 300 kJ. A prototype 300-KJ Marx has been built and tested at the Los Alamos Scientific Laboratory. This has been used as a test bed for components, triggering, and instrumentation. 4 Refs.

Primary Keywords: Marx Generator; Design Considerations; Reliability; Life Test; Low Inductance  
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562  
(POWER CONDITIONING)  
(Pulse Forming Networks)  
HIGH-VOLTAGE MICROSECOND PULSE-FORMING NETWORK

K.B. Rippe  
Los Alamos National Labs, Los Alamos, NM 87545  
The Review Of Scientific Instruments, Vol. 48, No. 8, pp 1028-1030 (08/1977).

A large CO/sub 2/ laser being developed at Los Alamos Scientific Laboratory for fusion research requires a high-voltage, high-power pumping pulse of several microsecond duration. A pulse generator has been developed which provides a flat-topped pulse of 120 kA at 300 kV into a matched impedance load, with a 2.5-microsecond pulse duration. The design is based on a combination of the Guillemin and Marx circuits. Eight of these will be used to pump an eight-beam laser system. There are applications for this circuit in other fields, such as electron beams for plasma heating. Design techniques for the pulse-forming network are discussed, including physical layout and triggering techniques. 9 Refs.

Primary Keywords: Square Pulse; Marx Generator; Guillemin PFN; Modular Construction; 2.5 Microsecond Pulse Duration; 120 kA Current

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563  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
ON THE FORMATION OF PRECISION BEAMS IN MULTISECTION LINEAR ELECTRON ACCELERATORS

V.I. Artemov, I.A. Grishayev, I.M. Gugel', G.K. Dem'yanenko, N. Dobynya, V.V. Korniyenko, N.I. Mocheshnikov, F.A. Poyev and V.V. Petranko  
FTD Report No. FTD-ID(RS)T-1919-77 (11/1977).

Trans. From: Ordena Lenina Akademiyu Nauk USSR Ordena Lenina Fiziko-Tekhnicheskii Institut, Khfti: 71-31, Khar'kov, 1-30 (1971)

Availability: AD A065859  
NTIS

The authors describe a method of obtaining precision beams from a linear electron accelerator based on the use of communication of radial and phase motion. The effect of high-frequency and current instabilities on the parameters of the beam are investigated. A procedure for measurement of the emittance of the beam at the output of the accelerator is presented. Measurements of beam emittance are shown to 2 GeV. Experimental results are compared with theoretical calculations of the beam parameters. 13 Refs.

Primary Keywords: E-beam; Linear Accelerator; Precision Beam; Instabilities; Emittance Measurement; Experiment; Theory

572  
(BREAKDOWN STUDIES)  
(Reviews)  
OPTICAL DISCHARGES

Yu. P. Raizer  
Institute For Problems In Mechanics, Moscow, USSR  
Journal De Physique, Vol. 7, No. 40 pp. 141-147 (07/1979).  
The author discusses the mechanisms involved in discharges initiated by laser radiation. A comparison of optical discharges with discharges of other types is made. The maintenance of equilibrium and non-equilibrium plasma is discussed as is optical discharge propagation. 15 Refs.

Primary Keywords: Optical Discharge; Threshold Field; Non-equilibrium Plasma  
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573  
(ENERGY STORAGE, INDUCTIVE)  
(Systems)  
PULSED SUPERCONDUCTING INDUCTIVE STORAGE SYSTEM

D.K. Mavardi and H.K. Chung  
Case Western Reserve University, Cleveland, OH 44106  
1976 IEEE Pulsed Power Conference Proceedings, Paper IID-5 (11/1976).  
A novel pulsed inductive storage system is described. This system is the electromagnetic dual of the Marx generator used extensively in high voltage research. In our scheme a number of superconducting inductors are energized in series and subsequently discharged in parallel. The advantage of our scheme is that it spreads the energy stored over several inductors, reducing the current rating of the switches needed to provide the series-parallel interconnection. Furthermore, it improves appreciably the efficiency of energy transfer from the storage inductors to the load as compared to the efficiency of an inductive system using one storage inductor only. The feasibility of this inductive system is demonstrated on a system consisting of three storage inductors. The inductors are energized by means of flux pump of the Wipf design and the switches used are superconducting M-switches (US patent 3,384,767) with a very fast response time. 7 Refs.

Primary Keywords: XRAM; Series Charge; Parallel Discharge; High Efficiency; Flux Pump; M-switch; Inductive Load  
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574  
(ENERGY STORAGE, MECHANICAL)  
(Rotating Machines)  
PARAMETER ESTIMATION FOR GENERATOR SIMULATION STUDIES

R.P. Webb (1), C.W. Brice (1), D.T. Tan (2) and C.C. Lee (2)  
(1) Georgia Institute of Technology, Atlanta, GA 30332  
(2) LRU, Baton Rouge, LA 70803  
AFAPL Report No. AFAPL-TR-77-69 (11/1977).  
Availability: AD A57006  
NTIS

This report presents a detailed study of alternator parameter estimation procedures, including comparison of theoretical results to test data and to simulation results. 36 Refs.

Primary Keywords: Generator Modeling; Sensitivity Analysis; Parameter Identification; Simulation

579  
(PULSE GENERATORS; ENERGY STORAGE, CAPACITIVE)  
(LC; LC Generators)  
15-KJ LC GENERATOR: LOW INDUCTANCE DEVICE FOR A 100-GW PULSED ELECTRON ACCELERATOR

N.W. Harris (1) and H.I. Milde (2)  
(1) Naval Research Lab, Washington, DC 20375  
(2) Ion Physics Corp, Burlington, MA 01803  
Journal Of Vacuum Science Technology, Vol. 12, No. 6, pp 1188-1190 (12/1975).

In this paper the author describes an LC generator used to charge a pulse forming line in an e-beam generator. The LC generator is both more efficient and allows shorter pulses than a Marx driven system. This is due to the fact that the intermediate store is eliminated. Switching inductance and rise time are considered. 3 Refs.

Primary Keywords: LC Generator; Water Line Pulse Charging; Pulse Forming Line  
Secondary Keywords: E-beam Generation  
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580  
(ENERGY STORAGE, MECHANICAL)  
(Rotating Machines)  
PROGRAM FOR THE DEVELOPMENT OF A SUPERCONDUCTING GENERATOR

J.L. McCabria  
Westinghouse Electric Corp, Lima, OH 45802  
AFAPL Report No. AFAPL-TR-79-2012 (02/1979).  
Availability: AD A072093  
NTIS

This report summarizes work completed in Phase II and Phase III of a program for the development of a superconducting generator. A 5 MW, 400 Hz, 12000 rpm generator was designed and built during Phase II. The oil cooled stator contained a 3-phase, wye connected, 5 kV, flooded winding within a laminated iron shield. The rotor contained a winding of 0.094 cm x 0.14 cm wire with 438 36 micron filaments of Nb-Ti superconducting alloy. A rotating dewar with a cold electro-thermal shield was used. The Phase III work consisted of a warm spin-up of the generator to design speed followed by cool-downs of the rotor. A superconducting state was not obtained in a generator configuration due to high pressure in the vacuum space which resulted in excessive gas conduction into the field winding compartment. A continuous pump-down system was incorporated into the test set-up but the helium leakage rate exceeded the capability of this system. Further work is required to correct this problem. 23 Refs.

Primary Keywords: Superconductors; Cryogenics; Helium; Light Weight; High Power  
Secondary Keywords: Generators

589  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
HARP: A SHORT PULSE, HIGH CURRENT ELECTRON BEAM ACCELERATOR

K.R. Prestwich  
Sandia Labs, Albuquerque, NM 87115  
IEEE Transactions On Nuclear Science, Vol. NS-22, No. 3, pp 975-978 (06/1975).

A 3 MW, 800 kA, 24 ns electron beam accelerator is described and the results of initial switching experiments are discussed. The generator will provide a source for studying the physics of processes leading to electron beam driven, inertially confined fusion. The major components of the accelerator are two diodes with a common anode, twelve oil-dielectric Blumleins with low jitter (<2 ns) multichannel switches, three intermediate storage capacitors, a trigger pulse generator and two Marx generators. 6 Refs.

Primary Keywords: Field Emission Diode; Oil Blumlein Line; Oil Rail Gap; Multichannel Spark Gap  
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# 595 (PULSE GENERATORS: PARTICLE BEAMS, ION)

(Systems: Generation)

## MAGNETICALLY INSULATED LINAC DRIVEN BY A MULTISTAGE MARX GENERATOR

F. Winterberg

University of Nevada System, Reno, NV 89507

Zeitschrift für Physik A, Vol. 280, No. 4, pp 359-362 (01/1977).

A method of accelerating intense ion beams so that the ions have an energy of about 5 GeV using a multistage Marx generator to drive a magnetically insulated linear accelerator is presented. This proposed scheme allows the accelerator to be much shorter than conventional setups using microwave driven lines. With proper scaling of the original plan, beam powers up to 500 TW should be attainable. 11 Refs.

Primary Keywords: Marx Generator; Magnetic Insulation; Heavy Ion Beam; Multi-GeV Energy; Very High Current

Secondary Keywords: Beam Fusion

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# 597

## (PULSE GENERATORS: ENERGY STORAGE, CAPACITIVE)

(Marx: Marx Generators)

### OVERVOLTAGE AND BREAKDOWN PATTERNS OF FAST MARX GENERATORS

R.W. Morrison and A.M. Smith

Carleton University, Ottawa, Ontario, Canada

IEEE Transactions On Nuclear Science, Vol. NS-19, No. 4, pp 20-31 (08/1972).

Spark gap overvoltages of fast Marx generators in the 100-300 kV range were studied as a function of stray and interstage capacitance for several circuit designs. Overvoltage measurements were made at low voltages by simulating the spark with a silicon-controlled rectifier. Breakdown times were measured to nanoseconds by viewing the light flash from the sparks with a fast photomultiplier. The influence of the ultraviolet irradiation on breakdown time was studied by masking the first gap. Practical conclusions for Marx generator design are presented. 10 Refs.

Primary Keywords: Marx Erection Time; Gap Overvoltage; Stray Capacitance; Interstage Capacitance; Thyristor Simulation; Analysis

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# 602

## (SWITCHES, CLOSING)

(Ignitrons)

### REVERSE CURRENT AND ARC-BACK IN A SINGLE-GAP MERCURY-ARC VALVE

C.E. Fernando

Central Electricity Generating Board, London, UK

Proceedings Of The IEEE, Vol. 59, No. 4, pp 534-538 (04/1971).

Arc-backs produced by continuously raising the stress on a high-voltage single-gap single-anode mercury-arc valve are preceded by a change in reverse current before failure occurs. On the cycle at which arc-back occurs the reverse current rises rapidly to about 10 A at peak reverse voltage (140 kV maximum). Subsequently, the reverse current decreases and then rises again steadily for several hundred microseconds. Failure occurs during this second rise of current. These changes in reverse current prior to arc-back are reproducible. The peak reverse voltage reached on the cycle at which arc-back sets in is also reproducible (to  $\pm 10$  percent). This type of arc-back is interpreted as a sequential process that is initiated by ignition at peak voltage, of a stable high-voltage discharge in the valve. The subsequent rise of reverse current which leads to failure is attributed to a rise in gas pressure within the valve due to ion bombardment from the high-voltage discharge. The measured delay of 60 microseconds from the point of rapid rise in reverse current to the start of the final growth of current suggests that mercury vapor is evolved from the negatively biased main anode to cause a rise in gas pressure. Detection of precursor currents might allow suspect valves to be blocked in time to prevent the occurrence of a full arc-back. 23 Refs.

Primary Keywords: Arc-back Mechanism; Power Frequency; Device Failure Modes

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# 605

## (PARTICLE BEAMS, ELECTRON; PULSE GENERATORS)

(Generation: Marx)

### A NEW METHOD OF EXCITING UNIFORM DISCHARGES FOR HIGH PRESSURE LASERS

R.W. Morrison and C. Swail

Carleton University, Ottawa, Ontario, Canada

Physics Letters, Vol. 40A, No. 5, pp 375-377 (08/1972).

A Marx generator producing 50 kV pulses lasting 20 ns is used to create a uniform discharge by field emission from a stainless steel wire cathode in a TEA carbon dioxide laser. Variations in peak power, delay time, and pulse width with nominal Marx voltage are given. 5 Refs.

Primary Keywords: Field Emission Large Area Diode; Marx Generator; Townsend Avalanche; Space Charge Limited

Secondary Keywords: Gas Laser Pumping

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# 606

## (PULSE GENERATORS: SWITCHES, CLOSING)

(Systems: Gas Gaps, Electrical)

### A SIMPLE SYSTEM PRODUCING A 450 KV PULSE WITH 1 NS RISE TIME

K. Eggert

Physikalisches Institut, Technische Hochschule Aachen, Aachen, FRG

Nuclear Instruments And Methods, Vol. 106, No. 3, pp 509-512 (03/1973).

A simple pulse shaping network is described. It consists of a capacitor connected in series with a sparkgap. A Marx generator feeds the system. Calculations of the equivalent circuit reproduce the behaviour of the pulseformer, which generates a pulse of 450 kV with 1 ns rise time and 7 ns FWHM on a load of 80-ohm. With such a system streamer chambers can be driven quite conveniently. 1 Refs.

Primary Keywords: Marx Generator; Peak-to-Peak; Intermediate Storage Capacitor; Rise Time Reduction

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# 611

## (PULSE GENERATORS: ENERGY STORAGE, CAPACITIVE)

(Marx: Marx Generators)

### COMPACT, ULTRA-HIGH DENSITY MARX GENERATOR

D.M. Strickland and W.L. Heatherly

AFLC, Kirtland AFB, NM 87117

IEEE 1973 Eleventh Modulator Symposium pp. 113-120 (09/1973).

This report presents the results of an Air Force Weapons Laboratory program to develop a compact, high-density energy storage system to satisfy various electromagnetic pulse simulation requirements. Such requirements range from small, 1-MV ground-based simulators to elevated or air-supported simulators producing tens of megavolts. Based on a study performed during the High Altitude Simulation program and reported in the EMP-HAS report series, it was concluded that the most versatile and promising pulse generator system for matching this broad range of requirements would utilize a Marx generator and a distributed inductor-capacitor circuit. 5 Refs.

Primary Keywords: Marx Generator; Peak-to-Peak; Peak-to-Peak; Peak-to-Peak; Peak-to-Peak

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# 613

## HIGH-VOLTAGE TECHNOLOGY FOR THE LASL IMPLSION-HEATING EXPERIMENT

J.E. Menzel, I. Henins, J. Marshall and A.R. Sherwood

Los Alamos National Labs, Los Alamos, NM 87545

No. CONF-731114-58, 4p (01/1973).

Availability: LA-UR-73-1753

1815

For abstract, see NSA 29 06, number 14460.

Primary Keywords: Pulse Generators Specifications; Toroidal Theta Pinch Devices; Plasma Heating; Electronic Equipment; Implosions

Secondary Keywords: AEC

# 615

## (SWITCHES, CLOSING)

(Gas Gaps, Optical)

### PRECISE LASER INITIATED CLOSURE OF MULTIMEGAVOLT SPARK GAPS

J.J. Moriarty (1), H.I. Milde (1), J.R. Battis (2) and A.H. Guenther (2)

(1) Inn Physics Corp, Burlington, MA 01803

(2) AFML, Kirtland AFB, NM 87117

The Review Of Scientific Instruments, Vol. 42, No. 12, pp 1767-1776 (12/1971).

Single- and double-channel laser triggered switches in high pressure gas have been designed and operated in the voltage range from 1 to more than 3 MV. Jitter times of  $<1$  to 3 nsec were observed in most cases. Gas pressures of 10.5 and 21 kg/cm<sup>2</sup> were used. The gases were either 100% nitrogen or various mixtures of N<sub>2</sub> and 2% SF<sub>6</sub> and Ar. Significant accomplishments were (1) the simultaneous firing of four stages of a Marx generator by an optically divided laser beam, (2) up to 40% reduction in the rise time observed in the output pulse from a multimegavolt DC generator when switched into a load through two simultaneously laser triggered channels, and (3) the design operation of a laser triggered, DC charged switch at more than 3 MV. 23 Refs.

Primary Keywords: Laser-Triggered Spark Gap; Single Spark Channel; Double Spark Channel; Ruby Laser; Various Gases; High Pressure; Marx Generator

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# 618

## (PARTICLE BEAMS, ELECTRON; PARTICLE BEAMS, ELECTRON)

(Generation: Transport)

### PRODUCTION AND DYNAMICS OF HIGH INTENSITY ELECTRON BEAMS

G. Bratti (1), I. Boscolo (2), R. Coisson (2), M. Leo (2), A. Luches (2) and A. Tapparo (2)

(1) Università Di Bari, Bari, Italy

(2) Università Di Lecce, Lecce, Italy

IEEE Transactions On Nuclear Science, Vol. NS-20, No. 3, pp 286-288 (06/1973).

High intensity electron beam experiments are in progress at electron energies varying from 100 keV to 2 MeV. The low energy machines are Marx generators, while the high energy one is an electron beam transformer accelerator, home made with some original technical solutions. Its electron energy is 2 MeV, current  $>10$  kA, pulse length 20 ns at a repetition rate of 10 pps. The purpose is injection in the ANEL-type electron ring accelerators, beam dynamics and plasma-beam interaction investigations. Several models of field emission diodes have been investigated by various diagnostic methods and beam pictures on various materials have been taken. 3 Refs.

Primary Keywords: ANEL; Field Emission Diode; Magnetic Field; Bunching

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# 619

## (PULSE GENERATORS)

(Marx)

### PULSE GENERATORS AND MODULATORS FOR LASER APPLICATIONS

L.N. McCluskey, E.L. Roy, W.H. Gurley, C.M. Bouden, A.H. Markheiser and C. Casper

Army Missile Command, Redstone Arsenal, AL 35809

IEEE 1973 Eleventh Modulator Symposium pp. 121-128 (09/1973).

A high voltage pulse generator has been constructed for laboratory use in powering a high average power pulse laser. The pulse generator has three 500 kVA power transformers, a 3-phase rectifier and four mechanically synchronised 5-stage Marx generators. At 70 kV charge voltage 350 J are stored. Instabilities in the laser load are observed at approximately 70 kV charge. Very satisfactory 4 second operations of the pulse generator have been achieved at a PRF of 50 pps which corresponds to an average output power of 280 kW at 300 kV peak. 8 Refs.

Primary Keywords: Marx Generator; High Rep-rate; Design Considerations; Mechanical Synchronization; Variable Pulse Width

Secondary Keywords: Laser Load

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# 620

## (ENERGY CONVERSION, ELECTRICAL)

(Charging Circuits)

### STREAMER CHAMBER CHARGING REGULATOR SYSTEM

R.E. Fure and J.W. Dawson

Argonne National Lab, Argonne, IL

Nuclear Instruments And Methods, Vol. 100, No. 2, pp 329-331 (04/1972).

In a streamer chamber system being built at Argonne National Laboratory, the specifications for pulse repeatability impose stringent requirements on the Marx generator charging electronics. A charging regulator using type 284 tetrode modulator tubes was developed to provide the required stability. The system philosophy, design requirements, and circuit configuration are discussed. 2 Refs.

Primary Keywords: Marx Generator; Blumlein Line; 0.1 Percent Repeatability; Series Regulator

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# 621

## (PULSE GENERATORS)

(Marx)

### THE GENERATION OF LIGHTNING AND SWITCHING IMPULSE VOLTAGES IN THE UHV

A. Rodewald and K. Feser

Haefel, Ltd., Basel, Switzerland

IEEE Transactions On Power Apparatus And Systems, Vol. PAS-93, No. 1, pp 414-420 (02/1974).

This paper concerns the trigger performance of Marx circuits and shows the essential features of an improved circuit. It is studied how the introduction of parallel spark gaps PF and firing capacitors C/sub 2/ in a multistage impulse generator can improve the trigger performance. Other advantages of the new circuit will also be discussed. 15 Refs.

Primary Keywords: Marx Generator; Trigger Performance; Design Considerations; Principles Of Operation; Sphere-Sphere Gap; Improved Circuit; Parallel Spark Gaps

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622  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
**THE HYDRA ELECTRON BEAM GENERATOR**  
T.M. Martin  
Sandia Labs, Albuquerque, NM 87115  
IEEE Transactions On Nuclear Science, Vol. NS-20, No. 3, pp 289-293  
(06/1973).  
The Hydra electron beam generator was designed to simultaneously produce two 1 MV, 0.5 MA, 80 nanosecond electron beams that could be combined to form a single beam. The machine, undergoing final developmental tests, has generated a 0.5 MA, 1 MV peak electron beam from each line. This accelerator consists of a low-inductance Marx generator, two water-dielectric pulseforming (PF) and impedance-transforming transmission lines and two low-inductance, high-current diodes. A description of the generator is presented along with developmental studies and initial testing data. The Hydra machine is based on accelerator principles described in the literature. The Marx generator is submerged in transformer oil and separated from the transmission line water by a lucite interface. The Marx charges each coaxial PF transmission line which is insulated by deionized water to 3 MV in 0.9 microseconds. At peak voltage a 3 MV SF/sub 6/ spark gap electrically connects the 4 ohm PF line to the impedance transforming (4 ohm to 2 ohm) transmission line. The pulse is transmitted through this line to the single radial insulator diode. A 30 kilojoule, 100 nanosecond duration electron beam is formed by a cold cathode in each diode. 12 Refs.  
Primary Keywords: Marx Generator; Pulse Forming Line; Impedance Matching; Field Emission Diode; Design Considerations  
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624  
(SWITCHES, CLOSING)  
(Solid Dielectric, Optical)  
**LASER-TRIGGERED SOLID DIELECTRIC SWITCHING**  
M. Ury, D. Morse and M. Friedman  
Cornell University, Ithaca, NY 14850  
IEEE Transactions On Nuclear Science, Vol. NS-18, pp 314-321 (01/1971).  
A Q-switched ruby laser was used to initiate breakdown in solid dielectric switches with a jitter of less than 3 ns. Polycarbonate in thickness from 40 to 80 mils withstood applied voltage pulses (less than 1 microsecond duration) of up to 400 kV. Laser pulse energy of less than 1 joule was sufficient to initiate breakdown in the solid dielectric. A focusing lens and the switch container were immersed in a grading solution of copper sulfate and water. Command triggering down to 50% of the dielectric's self breakdown voltage was demonstrated. A test system employing a miniature Marx generator, and a high energy system switching 150 kA at 400 kV to form precisely time relativistic electron beams, are described. 5 Refs.  
Primary Keywords: Ruby Laser; Polycarbonate Dielectric; Low Energy Laser; Wide Voltage Range; Sphere-plane Gap  
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625  
(BREAKDOWN STUDIES)  
(Gas, Optical)  
**OBSERVATION OF HIGHLY IONIZED SPECIES IN PLASMA PRODUCED BY PICOSECOND LASER PULSES**  
R.J. Doherty, C.J. Part and S.A. Ramsden  
University of Mull, Mull, UK  
Optics Communications, Vol. 9, No. 3, pp 287-290 (11/1973).  
Results are presented of an experiment to measure the breakdown of a solid target by laser radiation in a vacuum. The laser used was a mode-locked Nd:glass ring laser. This laser was used to irradiate PTFE, carbon, and aluminum targets. Spectra were taken using a normal incidence spectrometer having a resolution of about 0.5 angstroms. plots are shown of PTFE and aluminum spectra. 11 Refs.  
Primary Keywords: Nd-glass Laser; PTFE Target; Aluminum Target; Normal Incidence Spectrometer  
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626  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
**NEREUS, A 250 KV, 80 KA ELECTRON BEAM GENERATOR**  
K.R. Prestwich  
Sandia Labs, Albuquerque, NM 87115  
IEEE Transactions On Nuclear Science, Vol. NS-18, No. 3, pp 493-495  
(03/1971).  
A 250 - 400 kV, 80 kA, 30 ns electron beam generator has been developed. The machine consists of a 600 kV Marx generator, a water-dielectric transmission line, a diode, and a beam drift chamber. It was necessary to minimize prepulse for stable diode operation. Several cathodes were tested during development and results are reported. Diodes with 26 and 8 nH inductance are described. 4 Refs.  
Primary Keywords: Field Emission Diode; Drift Tube; Marx Generator; Water-dielectric Transmission Line; Several Cathode Materials  
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628  
(PULSE GENERATORS; ENERGY STORAGE, CAPACITIVE)  
(Marx; Marx Generators)  
**DEVELOPMENT OF AN 18-MEGAVOLT MARX GENERATOR**  
K.R. Prestwich and D.L. Johnson  
Sandia Labs, Albuquerque, NM 87115  
IEEE Transactions On Nuclear Science, Vol. NS-16, No. 3, pp 64-69  
(06/1969).  
An 18-megavolt, 1 megajoule Marx generator has been constructed and tested to 11 MV as the primary energy store of the Hermes II flash x-ray machine. A geometrical arrangement for the capacitors that takes advantage of the stray capacitance to provide a wide triggering range and fast Marx erection time was developed from model and circuit studies. The design parameters of the Marx were checked by constructing and testing a 4 MV, 100 kJ generator using components proposed for the 18 MV system. Spark gaps were developed specifically for the generator and have operated successfully for over 50,000 gap firings. 6 Refs.  
Primary Keywords: 1 MJ Energy; Hermes II; Stray Capacitance; Reliable Triggering; Fast Rise Time; Good Reliability  
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630  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
**A STUDY OF THE DOUBLE-FOCUSING DIODE**  
K. Takagi  
Nagoya University, Nagoya, Japan  
Japanese Journal Of Applied Physics, Vol. 18, No. 12, pp 2255-2262  
(12/1979).  
Double-focusing diode characteristics are investigated with special emphasis placed on impedance and anode plasma density. A co-axial Marx generator was used to supply a rectangular pulse across a constant load. Two different types of anodes were used on the double-focusing diodes. One was a mesh anode with 75% transparency and the other was a range-thick carbon plate with a 6 mm hole in its center. The double-focusing diodes were found to have a reduced impedance and a denser anode plasma than single diodes. 17 Refs.  
Primary Keywords: Double-focusing Diode; Co-axial Marx Generator; Impedance Reduction; Very Low Impedance; Electron Reflexing  
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632  
(PULSE GENERATORS)  
(Systems)  
**DISTRIBUTED PARAMETER MODEL OF THE TRESTLE PULSER**  
T.H. Lohman, R.L. Mutchings and R. Fisher  
BDI Corp, Albuquerque, NM 87106  
2nd IEEE International Pulsed Power Conference Proceedings, pp 425-428  
(06/1979).  
A distributed parameter circuit analog model was developed to evaluate design improvements for the TRESTLE pulser. The approach for specifying the model network and estimating model parameters is given. Model results are shown to compare favorably to available measurements. The model's flexibility and economy allowed ready evaluation of potential modifications. 3 Refs.  
Primary Keywords: Marx Generator; Peaking Capacitor; Analysis; Modelling  
Secondary Keywords: EMP Generation  
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635  
(PULSE GENERATORS; ENERGY STORAGE, CAPACITIVE)  
(Marx; Marx Generators)  
**LOW-IMPEDANCE, COAXIAL-TYPE MARX GENERATOR WITH A QUASI-RECTANGULAR OUTPUT WAVEFORM**  
M. Obara, Y. Saketo, C.H. Lee, T. Hashimoto and T. Fujioka  
Keio University, Yokohama-shi, Japan  
2nd IEEE International Pulsed Power Conference Proceedings, pp 165-171  
(06/1979).  
Theoretical analysis of a low-impedance, coaxial type Marx generator, in terms of the equivalent electrical circuit, can offer the most appropriate parameters for the design of a Marx generator to produce a quasi-rectangular output waveform. The results of this theoretical analysis can be extensively applied to the design of various types of coaxial Marx generator. Based upon theoretical analysis, three Marx generators of 0.6MV, 1.0MV, and 2.6MV have been developed for the e-beam initiation of an HF chemical laser. The results of the analysis were in good agreement with the experimental results. They have a completely coaxial configuration. One advantage of these machines is that they can directly drive a low-impedance electron-beam diode, without a low-impedance PFN, for the efficient production of an intense relativistic electron beam. They are also remarkably compact. 16 Refs.  
Primary Keywords: Coaxial Marx Generator; Low-impedance; Quasi-rectangular Output; Theory; Experiment  
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638  
(PULSE GENERATORS)  
(Systems)  
**THE DESIGN APPROACH TO A HIGH-VOLTAGE BURST GENERATOR**  
D. Cummings and H.G. Hammon III  
Physic International Co, San Leandro, CA 94577  
2nd IEEE International Pulsed Power Conference Proceedings, pp 172-178  
(06/1979).  
An increasing number of experimental programs call for a sequence of several closely spaced, high-voltage pulses. This paper presents the various design considerations for such a system. These include the kind of pulse generator, series or parallel configuration, kinds of lines, aspect ratio, choices of dielectric, switch type, triggering considerations, Marx Generator design and isolation, feed problems, pulse formation, and waveform degradation with increasing stages. The design procedure is illustrated by the M-2 pulser built for the PHERMEX Facility at the Los Alamos Scientific Laboratory. This system produces a train of up to three 40 ns pulses, variable from 600 kV to 1.4 MV with pulse separations of 100 ns to 1 ms. Results are shown and waveforms presented. 9 Refs.  
Primary Keywords: Burst Mode; Design Considerations; PHERMEX; Experiment; Marx Generator; Pulse Line  
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641  
(PULSE GENERATORS)  
(Stacked Line)  
**A COMPACT POWERFUL-PULSE GENERATOR**  
Y Carmel, S. Eylon and E. Shohet  
Government Of Israel Scientific Department, Tel-Aviv, Israel  
Journal Of Physics E: Scientific Instruments, Vol. 11, No. 8 pp 746-750  
(08/1978).  
6 Refs.  
Primary Keywords: Stacked Line Transformer; Coaxial Marx Circuit; 25 ns, 100 kV Pulses  
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642  
(ENERGY STORAGE, CAPACITIVE; PULSE GENERATORS)  
(Marx Generators; Marx)  
**A LOW INDUCTANCE, COMPACT, 1 MV, 10 KJ MARX GENERATOR**  
R.D. Stine Jr.  
Maxwell Labs Inc, San Diego, CA 92123  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIC-2 (11/1976).  
The electrical characteristics and design features of a low inductance, compact, 1 MV, 10 kJ Marx generator are discussed. Generators with a wide range of output energies are easily obtained by series/parallel configurations of components. A precision triggered, three-electrode, 100 kV switch and the compact physical arrangement of plastic-cased capacitors results in less than 100 nH inductance per stage in the Marx. Reliable operation over a three to one voltage range is readily achieved by varying the spark-gap gas pressure. 3 Refs.  
Primary Keywords: Marx Generator; Low Inductance; Compact Size; Modular Design  
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643  
(POWER CONDITIONING)  
(Pulse Transformers)  
A REPETITIVE 600 KV STACKED LINE TRANSFORMER PULSE GENERATOR  
Y. Carmel and E. Shohet  
Israel Scientific Dept., Tel-Aviv, Israel  
Journal Of Physics E: Scientific Instruments, Vol. 11, pp 748-751  
(08/1978)  
A novel approach is described for the design of high-voltage fast pulse generators. It is based on a combination of a stacked line transformer (SLT) and a coaxial Marx circuit, whose principles were successfully applied for the design of a 600 kV, 25 ns repetitively pulsed generator. 1 Refs.  
Primary Keywords: Stacked Line Transformer; Coaxial Transmission Line; Marx Generator; Fast Rise Time  
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649  
(PULSE GENERATORS)  
(Systems)  
HIGH VOLTAGE NANOSECOND PULSE GENERATOR WITH VERY FAST RISE TIME  
Y. Kubota and A. Miyahara  
Nagoya University, Nagoya, Japan  
Japanese Journal Of Applied Physics, Vol. 17, No. 10, pp 1907-1908  
(05/1978)  
A description is given of a pulse generator producing a 300 kV, 5 ns pulse into a 5 ohm matching load with a rise time of 5 ns. A 720 kV Marx generator is inductively charged and then discharged through multichannel spark gaps providing the power for the pulse. 2 Refs.  
Primary Keywords: Marx Generator; Water Line; Self-break Water Switch; Sub-nanosecond Rise Time  
Secondary Keywords: E-beam Fusion  
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650  
(POWER CONDITIONING)  
(Voltage Regulation)  
HIGH-POWER PULSE GENERATION  
R. Arockiasamy and K. Kont  
Indian Institute Of Technology, New Delhi-110029, India  
Proceedings Of The IEEE, (August 1977), pp 1209-1210 (08/1977)  
A thyristor circuit for generating high-power pulses directly from the power frequency supply is described. The circuit has a wide scope of application in industry and research. Typical applications are mentioned. 3 Refs.  
Primary Keywords: SCR Power Conditioning; Power Control; Regulation; SCR Power Control; Poly Phase SCR Control; Power Rectification  
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653  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
MULTIPLE-WIRE ARRAY LOAD FOR HIGH-POWER PULSED GENERATORS  
C. Stallings, K. Nielsen and R. Schneider  
Physic International Co, San Leandro, CA 94577  
Applied Physics Letters, Vol. 29, No. 7, pp 404-406 (10/1976)  
Exploding wire loads have been used for several years to generate a hot dense plasma. For a generator with a rise time of tens of nanoseconds and an impedance of 1 ohm or less, the inductance of the wire load and the tendency of current to flow outside the wire limits the energy that can be transferred to the wire. An array of several wires has now been used to lower the inductance and improve the energy transfer. 8 Refs.  
Primary Keywords: Exploding Wires; Multiple-wire Array; 1 MA Current; Current Measurement; Impedance Matching  
Secondary Keywords: Plasma Generation  
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656  
(SWITCHES, CLOSING)  
(Gas Gaps, Optical)  
THE LASER TRIGGERING OF HIGH-VOLTAGE SWITCHES  
A.H. Guenther and J.R. Bettis  
AFNL, Kirtland AFB, NM 87117  
Journal Of Physics D: Applied Physics, Vol. 11, pp 1577-1613 (02/1978)  
The laser-triggered switching (LTS) of high-voltage spark gaps is considered. The basic theory is presented which predicts dependencies of the delay to breakdown and switching jitter on such variables as fill gas mixture and pressure, gap spacing, polarity, and geometry. It is shown that electrical arcs of several metres length can be directed by laser action. A complete set of experiments is reported which adequately support the proposed theory. The performance of LTS is considered and results are reported on multiple gap triggering, multiple channel triggering, triggering of voltages in excess of 3 MV, repetitive switching at rates up to 50 pps with subnanosecond jitter, as well as various geometries, pulse forming demonstrations, and output voltage selection on a Marx generator. Solid, liquid, and vacuum insulation mediums are also discussed and experimental results reported. Finally, numerous applications of LTS are presented as well as a list of recommended operating characteristics to obtain optimum switching performance. 126 Refs.  
Primary Keywords: Laser-triggered Spark Gap; Switch Delay; Jitter; Variable Pressure; Variable Gas Mixture; Variable Gap Spacing; Discharge Guiding; Experiment; Theory  
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658  
(PULSE GENERATORS)  
(Line Type)  
WAVE PROCESSES IN HIGH-POWER NANOSECOND PULSE GENERATORS  
Yu.P. Kubarkov  
M.I. Kalinin Leningrad Polytechnical Institute, Leningrad, USSR  
Soviet Physics-Technical Physics, Vol. 21, No. 4, pp 515-516 (04/1976).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 46, 884-886 (April 1976)  
The use of pulse forming lines in the production of electron beams is widespread today. As a result, it is necessary to characterize these lines and their pulse shaping characteristics. The solution proposed here is based on the principle of the superposition of the incident and reflected waves; the system is partitioned into several regions, which are treated as four-poles, whose parameters are governed by the design. Then, for the case in which reflected and incident waves are present, a solution is found in terms of the known reflection and refraction coefficients. To carry out calculations for a system consisting of coaxial lines it is sufficient to determine the amplitudes of the waves propagating in the forward and reverse directions in all regions. The number of these regions depends on the properties of the dielectric medium, the propagation velocity of the electromagnetic waves, the length of the system, and the time step of the calculation. After determining the numerical values for the forward and reverse waves throughout the system for a given time, we can determine the wave incident on the switches and the load. 3 Refs.  
Primary Keywords: Pulse Forming Line; Design Considerations; Switching Considerations; Modeling  
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671  
(PULSE GENERATORS; SWITCHES, CLOSING)  
(Capacitive, Thyristors)  
A FLEXIBLE HIGH POWER PULSE GENERATOR USING THYRISTORS  
D.F. Gibbs  
H.M. Willis Physics Lab, Royal Fort, UK  
Journal Of Physics E: Scientific Instruments, Vol. 4, pp 1065-1066  
(12/1971)  
A simple pulse generator is described which in conjunction with low voltage triggering equipment is capable of delivering pulses of up to 250 V into open circuit, with a source impedance of less than 1 kohm. Pulse width is variable from about 1 microsecond upwards. No difficulty is anticipated in producing higher voltages and currents if required. 0 Refs.  
Primary Keywords: Pulse Generator; Variable Pulse Width; Thyristor Switch; 250 V Output  
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675  
(PULSE GENERATORS; POWER CONDITIONING)  
(Marx; Pulse Forming Lines)  
HIGH-POWER CURRENT PULSE GENERATOR  
D.G. Zagorodnov, L.I. Bolotin, I.I. Magda, N.P. Gadetskii, V.I. Belysev and Yu.V. Tkach  
Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Kharkov, USSR  
Instruments And Experimental Techniques, No. 5, pp 1359-1361 (10/1970).  
Trans. From: Pribury i Tekhnika Eksperimenta 5, 100-102 (September-October 1970)  
A generator of high-power current pulses, 30 nsec wide, with the electron beam current reaching 12 kA at 400 kV is described. The generator consists of two forming lines with distilled water used as the dielectric and an electron gun with a multipointed cathode. The line is charged from a voltage pulse generator using the Marx-Mark circuit. Because water is used as the dielectric, the capacitance of the line is approximately 10 nF for relatively small dimensions, which allows approximately 0.5 kJ to be stored and approximately 1E9 W to be discharged into the load. 5 Refs.  
Primary Keywords: Marx Generator; Pulse Forming Line; Double Forming Line; Low Impedance; Water Dielectric; 400 kV Operating Voltage  
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681  
(PULSE GENERATORS; SWITCHES, CLOSING)  
(Line Type; RBD)  
AN ALL SOLID-STATE MODULATOR FOR THE ARSR-3 TRANSMITTER  
E.H. Hooper and S.R. Bird  
Hastinghouse Electric Corp, Baltimore, MD 21203  
IEEE Transactions On Electron Devices, Vol. ED-26, No. 10 pp 1496-1499  
(10/1979)  
This paper describes an all solid-state, high-power pulse modulator used in the ARSR-3 system (an FAA air route surveillance radar system). The modulator, the culmination of a number of years of both device and circuit development, uses fast switching Reverse Blocking Diode Thyristors (RBD's) to directly switch 14-MW, 3 microsecond video pulses at high current without the use of magnetic switching aids. The modulator consists of five identical PFN modules, a trigger amplifier, and a pulse transformer which matches the modulator output to the beam characteristics of a klystron. Each module contains its own PFN, discharge RBD switch assembly, and associated circuitry. This modulator is the first production equipment to use the new Hastinghouse T62R RBD devices. The devices switch 2200-A pulses with a turn-on rate of rise of up to 300 A/microsecond. 3 Refs.  
Primary Keywords: Pulse Forming Network; Reverse Blocking Diode Thyristor; Modular Design; Performance Test  
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684  
(BREAKDOWN STUDIES)  
(Lightning)  
SURVEY ON ACTUAL KNOWLEDGE AND PHYSICAL PROBLEMS  
K. Berger  
31 Gstaadstrasse, CH 8702, Switzerland  
Journal De Physique, Vol. 40 No. 7, pp. 57-62 (07/1979)  
An overview of recent lightning research is presented. Also discussed are three physical problems of lightning discharges: the problem of stepped leaders, of the velocity of leaders and return strokes, and of the current rise in the first and subsequent strokes. 0 Refs.  
Primary Keywords: Lightning Initiation; Charge Cells; Positive Particle Migration; Upward Leader; Downward Leader  
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686

(REVIEWS AND CONFERENCES)  
(Reviews)

## LECTURES ON HIGH-VOLTAGE AND PULSE POWER TECHNOLOGY

W.J. Sarjeant (Ed.)  
Los Alamos National Labs, Los Alamos, NM 87545  
Collection Of Lectures (10/1980)  
Availability:

See Individual Lectures

Thirteen lectures given at the University of New Mexico and Los Alamos Scientific Laboratory concerning pulse power. Topics discussed include energy storage, switching, power conditioning, and particle beam generation. Twelve lectures are referenced individually.

Primary Keywords: Power Conditioning; Power Supplies; Pulse Voltage Circuits; Transmission Lines; Capacitors; Loads; Thyratrons; Ignitrons; Charging; Pulse Transformers; E-beam; Grounding And Shielding

698

## NONADIABATIC ENERGY TRANSFER BETWEEN COUPLED L-C RESONATORS AND ITS POSSIBLE APPLICATIONS TO HIGH-POWER RF PULSE GENERATION

I. Sato, K. Minami and K. Ishii  
Nagoya University, Nagoya, Japan  
No. IPPJ-32, 53p (08/1979)  
Availability: NTIS

A principle of high-power RF pulse generation available in nuclear fusion research is proposed. The RF energy stored in L-C resonators with variable resonant frequencies is transferred to a load resonator when the frequency crossing occurs. Successive energy transfers from resonators result in a sustained RF oscillation at the load. It is emphasized that the successive triggering is not required in the present method. This simplifies substantially the operation of the RF generators. The principle is analyzed and numerically calculated for practical experimental conditions. An example of the conceptual designs of the variable inductor used in the present method is shown. At the frequency 1 MHz (4 MHz), the output 110 kW (440 kW) and the pulse width 24 sec (6 micron sec) are expected, if one uses two toroidal ferrite cores with a major radius 0.5m and a minor radius 0.2m.

Primary Keywords: Energy Transfer; Inductors; Nonadiabatic Conditions; Pulse Generators; Radio Frequencies; Resonators; Heating; Induction Heating; Nuclear Fusion; Radio Frequency Heating

Secondary Keywords: NTISNAAE; NTISFNJA

701

(SWITCHES, OPENING)  
(Explosive Fuses)

## ELECTRICAL EXPLOSION OF CYLINDRICAL FOILS IN AIR II. HIGH-CURRENT SHUNT PINCH

V.A. Burtsev, V.A. Dubynskii, M.P. Egorov, M.P. Kasatkina, A.B. Produvnov and I.V. Shestakov  
D.V. Efremov Institute, Leningrad, USSR  
Soviet Physics Technical Physics, Vol. 23, No. 9, pp 1851-1855 (09/1978)

Trans. From: Zhurnal Tekhnicheskoi Fiziki, Vol. 48, pp 1845-1852

The properties of the high-current pinch produced in the electrical explosion of a cylindrical aluminum foil in air are studied experimentally. With a thick foil the light pulse emitted from the plasma becomes sharper. Blackbody emission is obtained at wavelengths 270 nm  $< \lambda < 500$  nm. A current reversal arises in part of the plasma which coincides with the space-time position of the secondary shock wave. 9 Refs.

Primary Keywords: Exploding Cylindrical Foils; High-current Shunt Pinch; Cylindrical Aluminum Foil; Plasma Shock Wave; Secondary Shock Wave

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(SWITCHES, OPENING)  
(Explosive Fuses)

## ELECTRICAL EXPLOSION OF CYLINDRICAL FOILS IN AIR I. ELECTRICAL CHARACTERISTICS OF THE EXPLOSION

V.A. Burtsev, V.A. Dubynskii, M.P. Egorov, M.P. Kasatkina, A.B. Produvnov and I.V. Shestakov  
D.V. Efremov Scientific-Research Institute, Leningrad, USSR  
Soviet Physics Technical Physics, Vol. 23, No. 7, pp 802-806 (07/1978)

Trans. From: Zhurnal Tekhnicheskoi Fiziki, Vol. 48, pp 1419-1427

The experimental apparatus is described together with the diagnostic methods used to study the electrical explosion of cylindrical foils in air and the properties of the high-current shunt discharge. Experiments on the characteristics of the electrical explosions of cylindrical aluminum foils in air are reported. 23 Refs.

Primary Keywords: Cylindrical Foils; High-current Shunt Discharge; Megampere Current Switch; Suppressed Edge Effects

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(POWER CONDITIONING)  
(Pulse Transformers)

## USE OF TRANSFORMERS IN PRODUCING HIGH POWER OUTPUT FROM HOMOPOLAR GENERATORS

M.M. Linton, R.D. Ford, D. Conte, M.B. Lindstrom and I.M. Vitkovitsky  
Naval Research Lab, Washington, DC 20375  
2nd IEEE International Pulsed Power Conference Proceedings, pp 83-86 (06/1979)

Analysis is presented for systems using high current pulse transformers to exploit the high energy storage capability of homopolar generators or other limited current sources. The stepped-up secondary current can be established either by current interruption when the primary is also used for energy storage or by commutation of current into the primary from a separate storage inductor. For high-power pulse generators the primary insulation and power supply are protected by subsequent crowbarbing of the primary. An example is given of a design for matching the NRL homopolar generator with 1.46 mH inductor to a 1-microH, megavolt level inductive pulse generator. 6 Refs.

Primary Keywords: Pulse Transformer; High Current; Crowbar; Inductive Energy Storage

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708

(SWITCHES, CLOSING; SWITCHES, OPENING)  
(Vacuum Tubes; Vacuum Tubes)

## VERY FAST, HIGH PEAK POWER PLANAR TRIODE AMPLIFIERS FOR DRIVING OPTICAL GATES

M.M. Howland, S.J. Davis and W.L. Gagnon  
Lawrence Livermore Lab, Livermore, CA 94550  
2nd IEEE International Pulsed Power Conference Proceedings, pp 246-249 (06/1979)

Recent extensions of the peak power capabilities of planar triodes have made possible the latter's use as very fast pulse amplifiers, to drive optical gates within high-power Nd:glass laser chains. These pulse amplifiers switch voltages in the 20 kV range with rise times of a few nanoseconds into crystal optical gates that are essentially capacitive loads. This paper describes a simplified procedure for designing these pulse amplifiers. It further outlines the use of bridged-1 constant resistance networks to transform load capacitance into pure resistance, independent of frequency. 4 Refs.

Primary Keywords: Pulse Amplifier; Planar Triode; Miller Effect; Grounded Grid

Secondary Keywords: Pockels Cell

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(PULSE GENERATORS; ENERGY STORAGE, CHEMICAL)  
(Flux Compression; Flux Compression Generators)

## EXPLOSIVE MAGNETIC FLUX COMPRESSION PLATE GENERATORS AS FAST HIGH-ENERGY POWER SOURCES

R.S. Caird, D.J. Erickson, W.B. Garn and C.M. Fowler  
Los Alamos National Labs, Los Alamos, NM 87545

1976 IEEE Pulsed Power Conference Proceedings, Paper IIID-3 (11/1976).

A type of explosive driven generator, called a plate generator, is described. It is capable of delivering electrical energies in the MJ range at 10 power levels. Plane wave detonated explosive systems accelerate two large-area metal plates to high opposing velocities. An initial magnetic field is compressed and the flux transferred to an external load. The characteristics of the plate generator are described and compared with those of other types of generators. Methods of load matching are discussed. The results of several high-power experiments are also given. 5 Refs.

Primary Keywords: Flux Compression Generator; Plate Generator; Performance Comparison; Load Matching

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716

(SWITCHES, CLOSING)  
(Thyratrons)

## HIGH VOLTAGE, LOW INDUCTANCE HYDROGEN THYRATRON STUDY PROGRAM

R.F. Corliss and D.V. Turnquist  
EGG Inc, Salem, MA 01970  
EPADCOM Report No. DELET-TR-2977-F (01/1981).  
Availability: AD A095278

NTIS

The second phase of a multi-phase program of research and development to gain the information necessary to fabricate a high voltage, low inductance hydrogen thyatron switch has now been completed. The thyatron is to be capable of switching tens of kilampères within tens of nanoseconds at voltage levels as high as 250 kV. To achieve low inductance, the thyatron is operated within a close-fitting coaxial current return. Both the tube and the return are made physically short, and the tube is designed such that the discharge is constrained to flow principally at the outer reaches of the device. A technique has been developed for modeling various types of box grids and then using computer-generated field plots to aid in the specific grid design. This model has been used to generate a comprehensive set of theoretical relations that are useful to determine the anode dissipation to be expected. Experimental results are described and discussed. Included are the ceramic test results, hold off vs. time on charge and gas pressure, stage voltage addition, operation at high pulse repetition rates, current rise time as a function of gas pressure, and the triggering characteristics of multi-stage, box-grid tubes. Finally, the design of an intermediate experimental tube is discussed at length. This tube is expected to have an inductance less than 50nH and to operate at 150kV. 5 Refs.

Primary Keywords: Thyratrons; Switches; Pulse Generators; Blumlines; Pulse Modulators; Nanosecond Pulsers; High Voltage Components

725

(POWER CONDITIONING)  
(Clippers)

## SOLID STATE CLIPPER DIODES FOR HIGH POWER MODULATORS

S. Levy and J.E. Creighton  
ECOM, Fort Monmouth, NJ 07703

1978 IEEE Thirtieth Modulator Symposium, pp 60-65 (06/1978).

End-of-line solid state clipper diodes are essential to high power pulse modulators. These diodes are chosen to reduce the potentially damaging inverse network and switch voltages which occur when the load is less than the network impedance; especially when non-constant loads are encountered. The choice of the clipper diode stacks for a megawatt (MW) average power pulser resulted from a study of commercially available units. Destructive tests of available units gave a figure of merit of 300:1 for the maximum single shot 10 microsecond current pulse to diode rated average current. A 150 Ampere (A) average current diode was chosen for the 20,000 A worst case expected in the MW pulser giving a current safety factor of better than 2:1. For the 40 kilovolt (kV) pulser operation at a 1.5:1 voltage safety factor required 60 of the 1.0 kV diodes in series. A snubber capacitor and resistor across each diode provided equal voltage division and transient turn-on protection. Transient response of the snubber protected diode stacks was modeled at low powers and later confirmed in actual MW pulser operation. 10 Refs.

Primary Keywords: End Of Line Clipper; Low Impedance Load; Non-constant Load; Reflected Voltage; Diode Tests; Snubber

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728  
(INSULATION, MATERIAL)  
(Liquid)  
THE COOLING OF OIL-FILLED ELECTRICAL EQUIPMENT, WITH SPECIAL REFERENCE TO HIGH POWER LINE-TYPE PULSE GENERATORS

G. Scoles  
English Electric Valve Co Ltd, Chelmsford, Essex, UK  
1976 IEEE Pulsed Power Conference Proceedings, Paper ITIE-4 (11/1976).  
Various methods are described for cooling the oil used to insulate the component parts of high voltage, high power line-type pulse generators and their power supplies. Efficiencies of mains transformers, charging inductors, pulse-forming networks, pulse transformers, etc., as well as the actual switching device are such that as much as 15 to 20% of the power consumed is likely to be dissipated as heat. A number of cooling systems are described, ranging from simple air convection to those using chimneys or fan-forced air. Water cooled heat exchangers also include those using convection in the oil as well as systems using pumps or propellers to cause the oil to flow rapidly past the cooled surfaces. The rate of heat extraction with these various systems can vary over a ratio of 1:100. In terms of watts per square foot of cooling surface per degree centigrade above ambient. Empirical results and formulae are given which enable the user to calculate heat extraction to a few percent in the majority of cases. 2 Refs.  
Primary Keywords: Oil Filled Equipment; Cooling; Efficiency; Convection; Forced Circulation; Water Cooling  
Secondary Keywords: Line Type Pulse Generators  
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733  
(PULSE GENERATORS)  
(Flux Compression)  
EXPLOSIVE ELECTRICAL GENERATOR  
E.I. Azarkavich, A.E. Voltenko, V.P. Tsakov and Yu.A. Kotov  
S.M. Kirlov Tomsk Polytechnical Institute, Tomsk, USSR  
Soviet Physics-Technical Physics, Vol. 21, No. 9, pp 1141-1144 (09/1975).

Trans. From: Zhurnal Tekhnicheskoi Fiziki, Vol. 46, Pp 1957-1962  
An experimental prototype of an explosive electrical generator is described. This device uses the energy of an explosion to produce electrical pulses in a resistive load. It consists of an explosive magnetic-field source, a fast-acting breaker, an explosion chamber, and other elements. A current of 140 kA is produced in a resistive load at a voltage of 120 kV with a pulse length 0.5  $\mu$ s. 21 Refs.  
Primary Keywords: Explosive Generator; Resistive Load; 140 KA Current  
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737  
(PARTICLE BEAMS, ELECTRON; SWITCHES, OPENING)  
(Generation; Explosive Fuses)  
HIGH-CURRENT NANOSECOND-PULSE ELECTRON ACCELERATOR WITH INDUCTIVE SHAPING ELEMENT  
Yu.A. Kotov, B.M. Kovalchuk, N.G. Kolodov, G.A. Mesyets, V.S. Sedoi and A.L. Ipatov  
Soviet Physics-Technical Physics Letters, Vol. 3, No. 9, pp 359-360 (09/1977).  
Trans. From: Pis'ma Zhurnal Tekhnicheskoi Fiziki 3, 883-886 (September 1977).  
The traditional high-current nanosecond accelerator contains a 'slow' energy storage bank, usually a pulse voltage generator, a 'fast' bank, which is a shaping line with a switching system, and a vacuum diode. Accelerators of this type are reviewed elsewhere. For electron energies above 1E6 V, for currents >50 kA, and for pulse lengths of 50 nsec or more, these accelerators become large, complicated, and expensive. Furthermore, the pulse length in these accelerators is essentially fixed since it is governed by the length of the shaping line. Low-energy pulsed accelerators in which the role of the 'fast' storage bank is played by the inductance of an LC circuit with an exploding-wire current breaker are discussed elsewhere. In the present letter we describe an accelerator which uses the same principle, but a pulse energy of the order of 1E4 J. This accelerator is designed for operation with short pulses (accelerator voltage U up to 2 MV, current I up to 50 kA, and pulse length t up to 100 nsec) and long pulses (U up to 500 kV, I up to 25 kA, and t up to 2.5 microsecond). 4 Refs.  
Primary Keywords: Stacked Line; Exploding Wire; Inductive Energy Storage; Pulse Transformer; Field-emission Diodes  
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739  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
CHARACTERISTICS OF IMPULSE BREAKDOWN OF STANDARD ROD GAPS UNDER CONTROLLED-ATMOSPHERE CONDITIONS  
J.E. Matthews and R. Saint-Arnaud  
University of Strathclyde, Glasgow, Scotland  
Proceedings of the IEE, Vol. 117, No. 10, pp 1524-1527 (10/1971).  
The effect of humidity on the impulse breakdown of rod-rod gaps is considered in this paper, along with the influence of gamma irradiation and polarity effects. It was found that the breakdown voltage increased in all cases except one, where the corona was believed to play a dominating role. A polarity effect was observed in non-irradiated gaps but is probably due to stray capacitance with the grounded vessel. Gamma irradiation of the gap produced strong polarity effects and breakdown voltage was reduced. 20 Refs.  
Primary Keywords: Impulse Breakdown; Humidity Effect; Radiation Effect; Gamma Radiation; Polarity Effect; Breakdown Voltage vs Humidity  
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743  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Reviews)  
NANOSECOND PULSE MEASUREMENTS  
C.N. Minningstad  
Tektronix Inc., Beaverton, OR  
IRE Western Electronic Show And Convention (WESCON) Paper 23/1 (01/1963).  
Nanosecond pulse propagation is analyzed utilizing transmission line theory techniques in this paper. TEF transmission lines (coaxial cable, strip lines, etc.) are shown to play a significant role in nanosecond pulse propagation for most applications. These analysis techniques are used to determine pulse delay characteristics, stray capacitance, inductance of signal injection and removal points. Design criteria are presented for voltage and current probes and sources, switches, and trigger circuits. 18 Refs.  
Primary Keywords: Transmission Line Theory; Current Probe; Voltage Probe; Skin Effect; Signal Source  
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745  
(ENERGY STORAGE, INDUCTIVE)  
(Systems)  
A PROPOSAL FOR THE CONSTRUCTION AND OPERATION OF AN INDUCTIVE STORE FOR 20 MJ

E.K. Inall  
Australian National University, Canberra, Australia  
Journal Of Physics E: Scientific Instruments, Vol. 5, pp 679-685 (07/1972).  
A proposal for coupling 15 MJ of energy initially stored in the Canberra homopolar generator, to a load in about 1.0 ms is described. 22 MJ is first transferred to a coaxial inductor at a peak current and voltage of 1.5 MA and 190 V respectively. Fast mechanical switches which are being developed would open to produce a potential of 1000 V and a peak power of 15 GW into the load. Information is given on the operation of a small version of the system being used to supply 100000 J to a high power laser amplifier. 6 Refs.  
Primary Keywords: Coaxial Inductor; Homopolar Generator; Mechanical Opening Switch; 1 ms Transfer Time; 1000 V Output Voltage  
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746  
(SWITCHES, CLOSING)  
(Gas Gaps, Optical)  
LASER TRIGGERING THROUGH FIBER OPTICS OF A LOW JITTER SPARK GAP  
M.C. Harjes, K.H. Schonbeck, M. Kristiansen, A.M. Guenther and L.L. Matfield  
Texas Tech University, Lubbock, TX 79409  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 3, pp 170-176 (09/1980).  
An optical filter is employed to transport a 15-ns light pulse from a high power ruby laser for precise triggering of a gas filled high voltage spark gap. The maximum power density that can be transmitted by the fiber is limited to 6E12 W/cm<sup>2</sup> above which laser induced damage occurs on the fiber entrance face. The overall throughput efficiency of the optical system was measured as 62 percent. Results are presented for the switching delay time and associated jitter for various mixtures of A and W/sub 2/ gas, and as a function of the voltage across a pulse-charged Blumlein generator. Pulse charging of the Blumlein generator was accomplished by a three-stage Marx generator, resulting in output voltages up to 250 kV. It was conclusively demonstrated that an optical fiber will transport a sufficiently intense laser pulse to evince subnanosecond jitter in the triggering of a pressurized gas switch under the conditions studied. 5 Refs.  
Primary Keywords: Laser Triggered Spark Gap; Fiber Optic; Ruby Laser; Power Density Limitation; Subnanosecond Jitter  
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747  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
LONG-LIFE HIGH-REPETITION-RATE TRIGGERED SPARK GAP  
M. Watson  
AirResearch Co., Torrance, CA 90509  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 3, pp 154-159 (06/1979).  
A forced-air-blown triggered spark gap (TSG) switch system capable of high repetition rates on a continuous basis as well as a TSG comparative study is described. The system consists of two TSG's, each discharging its own 30-ohm pulse cable into a common load. The system was operated at 30 kv, 1 kHz, for 39E6 shots with erosion rates of approximately 60 mg/amp-hour. Each TSG discharged 0.423 joules in 60 nsec (FWHM) per pulse. The switching losses were about 28 percent of the stored cable energy. Calculations indicate this can reduce to 14 percent by optimizing the TSG design and surrounding air channel insulation for a more uniform E-field. Test results indicate a multielement assembly capable of switching 50 kA or more 40- to 100-nsec pulses at 1 kHz from 50 kV for 50E6 shots without gas adjustment is feasible with this concept. The work was partially supported by the U.S. Energy Research and Development Administration under Contract No. EN-77-C-04-4048. 4 Refs.  
Primary Keywords: Rep-rated; Life Test; Electrode Erosion; Efficiency; Field Uniformity  
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749  
(SWITCHES, CLOSING; SWITCHES, CLOSING)  
(Gas Gaps, Self; Gas Gaps, Recovery)  
TESTING OF A 100-KV 100-HZ REP-RATE GAS SWITCH  
A. Ramrus and L. Shannon  
Maxwell Labs Inc, San Diego, CA 92123  
IEEE Transactions On Plasma Science, Vol PS-8, No. 3, pp 160-162 (09/1980).  
A two-electrode gas switch with a self-breakdown voltage of 100 kV was operated at a pulse-repetition rate (PRR) of 100 Hz with bursts up to 10 s in duration. The output of a pulse transformer provided the (1-cos omega t) waveform which charged the switch in about one-half ms. The switch discharged with a peak current of about 10 kA and a total charge transfer of about 10 mC into a damped LC circuit. A continuous purge of air through the interelectrode spacing enabled the switch to recover its breakdown voltage between discharges. Flow rates up to 35 standard cubic feet per minute (scfm) were employed. This paper discusses the dependence of switch jitter and waveform reproducibility on airflow rate. 3 Refs.  
Primary Keywords: Two Electrode Gas Gap; Air Gap; High Flow Rate; Rep-rated; Performance Test  
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751  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
ANODE BEHAVIOR IN HIGH INTENSITY FIELD EMISSION DIODES  
E. D'Anna, G. Leggeri, A. Luches, V. Nassisi, A. Perrone and M.R. Perrotti  
Universita di Lecce, Lecce, Italy  
Journal Of Vacuum Science And Technology, Vol. 17, No. 4, pp 838-841 (02/1980).  
The effects of energy loss in the anode foil of a field emission vacuum diode are considered experimentally and theoretically. The authors calculate the temperature rise in stainless steel foil for several beam energies and currents and 15 ns duration. The temperature rises calculated were not found to be sufficient to induce foil breakdown though experimental observation confirmed that this was, indeed, the case. A theory is presented to explain this discrepancy. 14 Refs.  
Primary Keywords: Field Emission Diode; Anode Foil; Beam Energy Deposition; Foil Heating  
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763

(SWITCHES, CLOSING)  
(Gas Gaps, Materials)

## EPOSION OF SPARK GAP ELECTRODES

R. A. Petr and T. R. Burkes  
Texas Tech University, Lubbock, TX 79409  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 3, pp 149-153  
(09/1980)

The erosion characteristics of spark gap electrodes operating with 10- and 20-microsecond square current pulses for various materials is presented. Cathode spot size and criteria for anode spot formation are estimated. Also, the effect of the acoustic properties on electrode erosion is described. 18 Refs.

Primary Keywords: Electrode Erosion; Square Current Pulse; 10-20 Microsecond Current Pulse; Several Electrode Materials; Cathode Spot; Anode Spot  
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770

(PARTICLE BEAMS, NEUTRAL)  
(Generation)

## LARGE AREA NEGATIVE ION SOURCE FOR HIGH VOLTAGE NEUTRAL BEAMS

P. Poulsen and E. B. J. Hooper  
Lawrence Berkeley Lab, Berkeley CA  
No. CONF-79102-89, 7p (11/1979)  
Availability: LBL-10081

A source of negative deuterium ions in the multi-ampere range is described that is readily extrapolated to reactor size, 10 amp or more of neutral beam, that is of interest in future experiments and reactors. The negative ion source is based upon the double charge exchange process. A beam of positive ions is created and accelerated to an energy at which the attachment process  $D^+ + M$  implies  $D^{2+} + M^{+1}$  proceeds efficiently. The positive ions are atomically neutralized either in  $D$  sub 2 or in the charge exchange medium  $M$ . Atomic species make a second charge exchange collision in the charge target to form  $D^{2+}$ . For a sufficiently thick target, the beam reaches an equilibrium fraction of negative ions. For reasons of efficiency, the target is typically alkali metal vapor; this experiment uses sodium. The beam of negative ions can be accelerated to high (>200 keV) energy, the electrons stripped from the ions, and a high energy neutral beam formed. (ERA citation 05:014561)

Primary Keywords: Ion Sources; Neutral Beam Sources; Beam Neutralization; Cations; Charge Exchange; Design; Deuterium Ions; Key Range 100-1000; Size  
Secondary Keywords: ERDA/700205, NTISDE

776

(BREAKDOWN STUDIES)  
(Gas, Electrical)

## PLASMA CONTRACTION CAUSED BY THE MAGNETIC FIELD OF THE CURRENT IN AN ELECTRON-BEAM-SUSTAINED DISCHARGE

V.V. Vladimirov, V.M. Gorshkov, V.F. Shandkii and A.I. Shchedrin  
Academy of Sciences of the Ukrainian SSR, Kiev  
Soviet Physics-Technical Physics, Vol. 49, No. 11, pp 1393-1394  
(11/1979)

Trans. From: Zhurnal Tekhnicheskoi Fiziki 49, 2473-2474 (November 1979)  
The externally sustained discharge has found widespread use in high-power gas lasers. Theory on the electron-beam-sustained discharge predicts a marked change in the spatial distribution of the beam electron energy loss as a result of the magnetic field produced by the discharge current. In turn, this nonuniform spatial distribution of the energy loss leads to nonuniform pumping of energy into the active medium, so that the optical emission suffers in quality. As we will show in the present paper, for discharge parameters in the 200-400 keV, 2 A/sq.cm. ranges magnetic mirrors can arise which prevent beam electrons from penetrating into the discharge once it has been established, so that the useful volume of the working chamber is reduced. 4 Refs.

Primary Keywords: E-beam-controlled Discharge; Spatial Discharge Distribution; D-charge Current; Discharge Field; Magnetic Mirror

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(BREAKDOWN STUDIES)  
(Gas, Electrical)

## PULSED BREAKDOWN OF GASEOUS HELIUM AT LOW TEMPERATURES

V.A. Avgustinovich (1) and Yu.G. Yushkov (2)  
(1) Scientific-Research Institute of Nuclear Physics  
(2) Tomsk Polytechnic Institute, Tomsk, USSR  
Soviet Physics-Technical Physics, Vol. 49, No. 11, pp 1415-1416  
(11/1979)

Trans. From: Zhurnal Tekhnicheskoi Fiziki 49, 2502-2503 (November 1979)  
An effort is currently being made to develop high-voltage devices which operate at low temperatures. In certain situations, in order to transfer the energy stored in a superconducting solenoid or high-Q microwave resonators, switches which are capable of operating in an atmosphere of gaseous helium at low temperatures are required. 7 Refs.

Primary Keywords: Helium; Impulse Breakdown; Point-plane Gap; Low Pressure; 4.2 Deg.K; 293 Deg.K; Variable Voltage Rise Time

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780

(SWITCHES, CLOSING; SWITCHES, OPENING)  
(Gas Gaps, E-beam; Gas Gaps, E-beam)

## REPETITIVE ELECTRON-BEAM CONTROLLED SWITCHING

R. F. Fernsler (1), D. Conte (2) and I. M. Vitkovitsky (3)  
(1) JAYCOR Inc, Alexandria, VA 22304  
(2) Research and Development Associates, Arlington, VA 22209  
(3) Naval Research Lab, Washington, DC 20375  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 3, pp 176-180  
(09/1980)

Previous investigators have demonstrated the feasibility of using an ionizing electron beam to control the conductivity of a gaseous volume-discharge switch. We consider the possibility of using such switches repetitively at high-power levels (up to 1E10 W), with switch opening and closing times as short as several nanoseconds. An analysis of the relevant gas chemistry indicates that these requirements can best be met by using a nonelectronegative base gas with a high electron mobility, diluted with a small percentage of an electronegative gas  $N_2$  sub 2, and the electronegative gas  $O_2$  sub 2, are presented to support the analysis. 10 Refs.

Primary Keywords: Nanosecond Closing Time; Nanosecond Opening Time; Chemistry Simulation; Nitrogen Gaps; Oxygen Gaps; Mixture; Rep-rated; Theory

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(PULSE GENERATORS)  
(Trigger)

## SIMPLE PULSE GENERATOR FOR A POWERFUL MODULATOR

B. Spagnolo  
Universita di Palermo, Viale delle Scienze, Italy  
The Review of Scientific Instruments, Vol. 51, No. 8, pp 1134-1136  
(08/1980)

A pulse generator circuit with pulse length 2.5 microns, peak voltage 1 kV, pulse repetition frequency 25-300 Hz, is described. This pulser may be used as a trigger for the thyatron of a 'line-type modulator'. 3 Refs.

Primary Keywords: 1 kV Output; Thyristor Pulser; 200 ns Rise Time; Low Impedance; Rep-rated

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798

(DIAGNOSTICS AND INSTRUMENTATION)  
(Current)

## MAGNETIC FIELD SENSITIVITY OF AN OPTICAL FIBER WITH MAGNETOSTRICTIVE JACKET

J. Jarzynski (1), J.H. Cole (1), J.A. Bucaro (1) and C.M. Davis (2)  
(1) Naval Research Lab, Washington, DC 20375  
(2) Dynamic Systems, Inc., McLean, VA 22102  
Applied Optics, Vol. 19, No. 22, pp. 3746-3748 (11/1980)

The authors derive expressions for the magnetically induced strain in an optical fiber with a finite magnetostrictive jacket. The effect of jacket thickness on the magnetic field sensitivity and pressure sensitivity of an optical fiber is calculated. 8 Refs.

Primary Keywords: Magnet Field Measurement; Optical Fiber; Magnetostrictive Jacket; Phase Shift

Secondary Keywords: Strain Calculation

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801

(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)

## A NANOSECOND RISE TIME DIFFERENTIAL PULSE TRANSFORMER

G.E. Albergo  
Eindhoven University of Technology, Eindhoven, Netherlands  
Journal Of Physics E: Scientific Instruments, Vol. 13, pp 1009-1010  
(01/1977)

A differential pulse transformer with a rise time of less than 2 ns and a drop of less than 1% for pulse widths up to 200 ns, is described. The device was primarily designed for the determination of small voltage differences in pulsed experiments on hot electrons in semiconductors. Special attention is paid to the systematic and random errors which may arise at the determination of differences. 4 Refs.

Primary Keywords: Instrumentation Transformer; Transmission Line Transformer

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828

(ENERGY STORAGE, MECHANICAL)  
(Rotating Machines)

## A MODEL AIR-SUPPORTED DRUM-TYPE HOMOPOLAR GENERATOR

R.L. Kustom, R.E. Fuya, R.B. Wehrle, R.P. Smith and T.J. Kovarik  
Argonne National Lab, Argonne, IL  
Argonne Report No. CONF-771132-6 (11/1977)  
Availability: CONF-771132-6

NTIS  
A single cylinder, drum-type homopolar generator has been designed and built for the purpose of developing a simple air support system for thin cylinder rotors operated at high surface velocities and significant radial drum growth. The model has an aluminum cylinder which is 0.32 cm thick, 25 cm in diameter, and 12.7 cm long. It is designed to operate at a peak current of 2500 A and to store a total of 40 kJ with a surface velocity of 305 m/sec. The drum is mounted over a fiberglass cylinder with its axis vertical. The space between the drum and the fiberglass cylinder form a pressurized air cavity. The drum is bounded between flat surfaces. Air escapes from the cavity between the edges of the cylinder and the flat surfaces. This provides the air lift to support the cylinder. Brushes are located at the edges of the cylinder in four clusters of eight brushes. The brush diameter is 0.36 cm. The peak current density is 781 A/sq.cm. The brush material is Morganite CMS. A radial magnetic field is provided by an iron core system using two copper coils. The field strength is 1.05 T. The model is in the initial stages of operation. It has been operated at 1500 rpm with a DC current of 100 A to test the air support system. It has been pulsed with 500 A peak current. Some problems have been encountered in the brush holder system which have required modifications. These modifications are in progress. 4 Refs.

Primary Keywords: Air Bearing; High Surface Velocity; Large Radial Drum Growth; Vertical Axis

831

(SWITCHES, CLOSING; SWITCHES, CLOSING; BREAKDOWN STUDIES)  
(Gas Gaps, Materials; Vacuum Gaps, Materials; Electrodes)

## ELECTRODES FOR HIGH-CURRENT COMMUTATORS

Yu.S. Pavlov and S.A. Smirnov  
Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Kharkov, USSR  
Instruments And Experimental Techniques, Vol. 14, No. 1, pp 132-134  
(02/1971)

Trans. From: Pribury i Tekhnika Eksperimenta 1, 118-120  
(January-February 1971)

This article describes two constructions of electrodes which provide for the directional movement of the discharge and its confinement within a specified region. The tests were carried out with current pulses of up to 100 kA in the range of pulse lengths up to 3 msec at atmospheric pressure and in a vacuum. It was established that the electrodes have a comparatively small erosion, while the ignition devices mounted on them are not covered with molten metal. As a result, the operating resource of arc gaps having such electrodes is increased considerably. 4 Refs.

Primary Keywords: Electrodes; Gas Gap; Vacuum Gap; Expanding Arc; Rotating Arc; Erosion Measurement; 100 kA Current

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832  
(BREAKDOWN STUDIES; SWITCHES; CLOSING)  
(Electrodes, Liquid Gaps, Materials)  
DEPENDENCE OF ELECTRODE EROSION UPON FORM OF CURRENT PULSE  
A. I. Kruglov and V. M. Fokin  
FTD Report No. FTD-11-64-857/1+2 (01/1965).  
Trans. From: Elektroiskrovaya Obrabotka Metallov Izdatel'stvo Akademii Nauk SSSR, 29-37 (1963)  
Availability: AD 611075  
NTIS

The authors show that the erosion of a copper or brass electrode immersed in kerosene is dependent not only on total charge passed by the electrode, but also on the shape of the current. Two pulse forming lines with pulse widths 1.5 and 20-microseconds, were utilized together to produce a pulse with variable shape. Peak currents were 60 A for the long pulse and 400 A for the short pulse. Evidence is presented that electrode erosion is significantly dependent on pulse shape parameters in a manner not predicted by previous theories. 7 Refs.  
Primary Keywords: Electrode Erosion; Pulse Shape; Low Current; Long Pulse; Rectangular Pulse; Significant Dependence

843  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
DEVELOPMENT AND INVESTIGATION OF RELATIVISTIC ELECTRON BEAMS WITH FINITE ENERGY SPREAD AND IMPROVED EMITTANCE  
J. Fink, H. J. Schilling and U. Schumacher  
Max-Planck-Institut für Plasmaphysik, Garching, FRG  
Journal Of Applied Physics, Vol. 51, No. 6, pp 2995-3000 (06/1980).

This paper presents experimental results in the development of lower-energy relativistic electron beams with finite energy spread, which - among other applications - is suitable for suppressing collective instabilities in an electron-ring accelerator. The measurements were performed with a divided cathode in an electron-gun gun, one half of which is connected via a resistor with the high-voltage terminal. The energy difference can be varied up to 100 keV in proportion to the resistance, with equal subcurrents. The beam parts are well separated, and their radial distance is about equal to the radial difference of the corresponding electron closed orbits, such that electron-ring formation with minimum radial betatron oscillations should be possible. The beam emittance is as small as about 100 mrad cm and the current is 800 A. 17 Refs.  
Primary Keywords: Electron Ring Accelerator; 100 Mrad Cm Emittance; 800 A Current

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854  
(SWITCHES, CLOSING)  
(Gas Gaps, E-beam)  
AN ELECTRON-BEAM-TRIGGERED SPARK GAP  
K. McDonald (1), M. Newton (1), E.E. Kunhardt (1), M. Kristiansen (1) and A.H. Gunther (2)  
(1) Texas Tech University, Lubbock, TX 79409  
(2) AFML, Kirtland AFB, NM 87117  
2nd IEEE International Pulsed Power Conference Proceedings, pp 437-441 (06/1979).

Studies on the triggering of a high-voltage, gas-insulated spark gap by an electron beam have been conducted. Rise times of approximately 2.5 ns and subnanosecond jitter have been obtained for 3 cm gaps with gap voltages as low as 50% of the self-breakdown voltage (variable to 1 MV). The switch delay (including the diode) was 50 ns. The working media were N/sub 2/, and mixtures of N/sub 2/ and Ar, and of N/sub 2/ and SF/sub 6/ at pressures of 1-3 atm. Open shutter photographs show that the discharge is broad in cross-section. Voltage, current, and jitter measurements have been made for a wide range of gap conditions and electron-beam parameters. Variations in the character of the discharge have been inferred using streak and open shutter photography. Correlation between electron beam width, beam energy, discharge channel width, current rise time, delay, and jitter are discussed. 7 Refs.

Primary Keywords: E-beam Triggering; High Voltage; Fast Rise; Low Jitter; Wide Trigger Range  
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869  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
A 3-MV LOW-JITTER TRIGGERED GAS SWITCH  
D.B. Cummings and H.G. Hanson III  
Physic International Co., San Leandro, CA 94577  
2nd IEEE International Pulsed Power Conference Proceedings, pp 446-449 (06/1979)

Physic International Company has designed, built, and tested a 3 MV, low jitter, triggered gas switch. The switch operates in a 16.5 ohm coaxial pulse line. The system design requires that the pulse line switches perform the difficult task of first holding off a reverse pulse charge, then of holding off the forward pulse charge, then, finally, of triggering on command. The trigger for the switch is generated by a trigger Marx placed within the output pulse line. The remainder of the triggering circuit includes a trigger isolation gap. A V/N-type trigger electrode is situated within the main gap. To date, the switch has been shown to hold voltage and trigger reliably for pulse charges from 0.9 MV to 2.5 MV. The rms jitter of the switch firing time is less than 6 ns. At an operating voltage of 2.5 MV, the switch transfers a charge of up to 0.1 coulomb per shot, with a peak current of 20 kA. 2 Refs.

Primary Keywords: Electrically Triggering; Very High Voltage; Reverse Voltage Holdoff; Low Jitter  
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871  
(ENERGY STORAGE, INDUCTIVE; ENERGY STORAGE, MECHANICAL)  
(Inductors; Rotating Machines)  
COMPUTER BASED ELECTRICAL ANALYSIS OF HOMOPOLAR GENERATOR DRIVEN BUTTERFLY PLATE STORAGE INDUCTORS WITH RADIAL CURRENT DIFFUSION  
D. J. T. Mynhall, H.G. Rylander, W.F. Weldon and H.M. Woodson  
University of Texas at Austin, Austin, TX 78712  
2nd IEEE International Pulsed Power Conference Proceedings, pp 330-332 (06/1979)

Maxwell's equations are solved for the operational admittance in the magnetic quasi-static approximation for nonmagnetic cylindrical coils with azimuthal currents and axial magnetic fields. An infinite series, Bessel function solution is obtained and solved for copper coils with given radial dimensions. Coil turns numbers and lengths are design parameters. A multiple branch, shunt network coil model with series resistances and inductances is derived. The UICEM 5 MJ homopolar generator is modeled with a torque-speed equation including brush and seal drag torques. The brush contact voltage drop is modeled versus surface speed and brush current. Transmission system resistances and inductances are included. Effective depths of current penetration, effective coil resistances and inductances, and peak temperatures are calculated versus time. Coil currents and voltages are obtained, as are system energy storages and dissipation. Peak current times and system discharge times are determined. Slightly underdamped configurations are found. 1 Ref.

Primary Keywords: Homopolar Generator; Analysis; Modelling; Design Parameters  
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873  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Electric Field)  
ELECTRIC POTENTIAL MEASUREMENTS IN GASEOUS INSULATING MATERIALS BY CORONA PROBE IN A CONTROLLED ENVIRONMENT  
S. Bertolini, A. Operto and G. Scutto  
University of Genoa, Genoa, Italy  
IEEE Transactions On Instrumentation And Measurement, Vol. IM-29, No. 2, pp 125-130 (06/1980)

The experimental determination of electric potential in gaseous insulating materials is performed using a corona probe. This method can be used to measure point values of electric potential from dc to ac at industrial frequency values. The proposed method, after an initial calibration of the probe, allows the determination of the amplitude of the electric potential at the point in space where the tip of the probe is located. The measurement is performed by adjusting the feeding potential of the probe until a complete corona suppression is obtained. To discriminate the corona effect of the probe from other possible corona sources, a device for probe current detection is proposed. The corona probe method has been verified by measuring electric potential under both dc and 50-Hz ac conditions, in known field configurations and in natural and controlled environments. Finally, the proposed method has been applied to determine the space distribution of the electric potential around high-voltage insulating structures under dc and 50-Hz voltages in a natural environment. 12 Refs.

Primary Keywords: Dc And 50-Hz; Spatial Distribution; Negative Potentials; Corona Current Measurement  
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875  
(SWITCHES, OPENING)  
(Vacuum Gaps, Electrical)  
EXPERIMENTS ON VACUUM INTERRUPTERS IN HIGH VOLTAGE 72 KV CIRCUITS  
R.E. Vorshall, C.W. Kimblin, P.G. Slade and J.G. Gorman  
Westinghouse Research and Development Center, Pittsburgh PA  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-99, No. 2, pp 658-666 (03/1980)

Three experimental 23 cm diameter vacuum interrupters have been built and their performance has been evaluated in single-phase high-voltage, high-current circuits. The first of these experimental designs contained 11.7 cm diameter, spiral electrodes and one floating arc shield. It interrupted bus circuits up to 42kV (72kV x 0.58/19kA). The second and third prototype designs contained three floating arc shields. Prototype number 2, equipped with 14 cm diameter, spiral electrodes, passed single phase bus fault tests at 42 kV/40 kA and 63 kV(72kV x 0.87)/30kA. The third prototype, designed to ensure that a diffuse vacuum arc could be maintained at very high currents, interrupted bus fault currents in the range of 40kA to 60kA in a 63kV circuit. This design also showed potential for series operation at 145kV/55kA for both bus and short line fault situations. Test data are presented in this paper and are discussed with respect to electrode diameter, the contact gap at current zero and the need for maintaining a diffuse vacuum arc. 1 Refs.

Primary Keywords: Vacuum Interrupters; Magnetic Field Interruption Mechanism; Electrode Vapor; Interruption Of Over 40kA (rms)  
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882  
(SWITCHES, CLOSING; BREAKDOWN STUDIES)  
(Liquid Gaps, Self; Liquid, Electrical)  
INDUCTANCE AND RESISTANCE CHARACTERISTICS OF SINGLE-SITE UNTRIGGERED WATER SWITCHES IN WATER TRANSFER CAPACITOR CIRCUITS  
P.W. Spence, Y.G. Chen, G. Frazier and H. Calvin  
Physic International Co., San Leandro, CA 94577  
2nd IEEE International Pulsed Power Conference Proceedings, pp 359-362 (06/1979)

Inductance and resistance characteristics of single-site untriggered water switch arc-channels have been investigated by measurement of their effects on frequency and voltage gain in a water capacitor transfer circuit. Data are presented for two distinct switch configurations covering a voltage range from 1.6 to 6 MV, gaps from 7 to 35 cm, and mean switching fields from 150 to 350 kV/cm. A simple lumped circuit model is postulated with switch L and R varying linearly with gap spacing under low voltage conditions. Extrapolation of this zero-order model to higher voltage conditions compares favorably with measured circuit characteristics. Energy loss in the water switch is observed to be approximately a factor of two in excess of maximum losses predicted from previous estimates. 3 Refs.

Primary Keywords: Resistance; Inductance; Variation With Gap Spacing; High Voltage; Efficiency; Rise Time Measurement  
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885  
(SWITCHES, CLOSING)  
(Thyristors)  
INSULATED-GATE PLANAR THYRISTORS. I. STRUCTURE AND BASIC OPERATION  
J.D. Plummer and B.W. Scharf  
Stanford University, Stanford, CA 94305  
IEEE Transactions On Electron Devices, Vol. ED-27, No. 2, pp 380-387  
(02/1980).  
A high-voltage planar triac which is controlled by an insulated-gate terminal is described. Its structure is related to the DMOS transistor on which it is based and its multiple operating modes are discussed in terms of an equivalent circuit composed of MOS and bipolar transistors and resistors. A typical junction isolated device has a 150-V breakdown and an on-resistance less than 10 Ohms for a 400-um wide channel. The on-resistance can easily be scaled to very low values simply by increasing the device width. Extension of the MOS thyristor concept to other devices and higher voltages is described. Quantitative analysis and modeling of these new devices are described in a companion paper. 23 Refs.  
Primary Keywords: High Voltage Planar Thyristor; DMOS Transistor; Insulated Gate Control; Metal Gate Technology; Modeling  
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888  
(SWITCHES, CLOSING)  
(Gas Gaps, Optical)  
LOW JITTER LASER TRIGGERED SPARK GAP USING FIBER OPTIC  
L.L. Matfield, M.C. Harjes, M. Kristiansen, A.H. Guenther and K.H. Schenbach  
Texas Tech University, Lubbock, TX 79409  
2nd IEEE International Pulsed Power Conference Proceedings, pp 442-445  
(06/1979).  
Laser triggering of a pulse charged gas switch is described. The laser triggering results in low jitter switching relative to the timing of the laser pulse. A novel feature is the use of a single element, 1 mm, quartz, optical fiber to transmit the laser beam. The fiber parameters, such as gas pressure, gas composition, and laser beam focal point location have been optimized to produce nanosecond delay and jitter with as little laser power as possible. The laser optical system has been optimized for best overall efficiency in a configuration suitable for illumination of many fibers by a single laser. Typical operating parameters for the switch are: 2 cm gap, 2500 Torr pressure, 50% Ar - 50% N<sub>2</sub> gas mixture, and a charging voltage of 200 kV. Laser power in the gas is typically a few megawatts with an overall efficiency greater than 50% for the optical system. 1 Refs.  
Primary Keywords: Laser Triggering; Fiber Optic; Low Laser Power; Low Jitter; Multiple Gaps  
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889  
(SWITCHES, CLOSING)  
(Miscellaneous Solid State)  
NEW TECHNOLOGIES ADVANCE POWER SEMICONDUCTOR STATE-OF-THE-ART  
R. Denning and J. White  
RCA Advanced Power Labs, Somerville, NJ  
Solid State Technology, (March 1980), pp 98-105 (03/1980).  
Improved manufacturability, performance, reliability and adaptability are features of a new series of discrete high voltage power devices. 16 Refs.  
Primary Keywords: 1.5 KV Breakdown; 10A Current; Neutron Doping; Ion Implantation; Diffusion Process; Surface Electric Field Control; Si/SiO<sub>2</sub> Passivation System; Metal System; Device Packaging; High Voltage Transistors; High Current Transistors  
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895  
(BREAKDOWN STUDIES)  
(Capacitors)  
POLARITY EFFECT MEASUREMENTS USING THE KERR ELECTRO-OPTIC EFFECT WITH COAXIAL CYLINDRICAL ELECTRODES  
M. Zohn and T.J. McGuire  
University of Florida, Gainesville, FL  
IEEE Transactions On Electrical Insulation, Vol. EI-15, No. 3, pp 287-293 (06/1980).  
Steady state solutions of the electric field and space charge density distributions using a drift dominated unipolar conduction model between coaxial cylindrical electrodes are reviewed and compared to experimental results obtained using the Kerr electro-optic effect. With coaxial cylindrical electrodes, Kerr measurements generally showed weak positive charge injection at the inner cylindrical electrode was so strong that the space charge shielding caused the electric field at the inner cylinder to be minimum, with the field increasing to the outer cylindrical electrode in complete contrast to the usual space charge free 1/r field dependence. This polarity effect is observed also for a sinusoidal ac high voltage with an essentially space charge free field when the inner cylindrical electrode was instantaneously negative, and a space charge distorted uniform field when the inner cylinder was instantaneously positive. 5 Refs.  
Primary Keywords: Space Charge; Charge Injection; Kerr Electro-optic Measurements; Coaxial Electrode Models; Breakdown In Dielectrics  
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897  
(SWITCHES, CLOSING; SWITCHES, OPENING)  
(Gas Gaps, E-beam; Gas Gaps, E-beam)  
ELECTIVE ELECTRON BEAM CONTROLLED SWITCHING  
R.F. Farnsler, D. Conte and I.M. Vitkovitsky  
Naval Research Lab, Washington, DC 20375  
2nd IEEE International Pulsed Power Conference Proceedings, pp 368-371  
(06/1979).  
Previous investigators have demonstrated the feasibility of using an ionizing electron beam to control the conductivity of a gaseous volume-discharge switch. We have considered the possibility of using such switches repetitively at high power levels (up to 1E10 W), with switch opening and closing times as short as several nanoseconds. An analysis of the relevant gas chemistry has indicated that these requirements can best be met by using a non-electronegative base gas diluted with a small percentage of an electronegative gas. Detailed chemistry simulations, using the non-electronegative gas O<sub>2</sub>/Ar 2%, have been performed and will be presented to support this analysis. Also discussed will be the limitations imposed by switch heating and gas breakdown. 6 Refs.  
Primary Keywords: Volume Discharge; Electronegative Seed Gas; Numerical Calculation; Chemistry Considerations  
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906  
(PULSE GENERATORS; ENERGY STORAGE, INDUCTIVE)  
(Systems, Systems)  
TRIDENT: A MEGAVOLT PULSE GENERATOR USING INDUCTIVE ENERGY STORAGE  
D. Conter, R.D. Ford, W.H. Linton and I.M. Vitkovitsky  
Naval Research Lab, Washington, DC 20375  
2nd IEEE International Pulsed Power Conference Proceedings, pp 276-283  
(06/1979).  
A megavolt level pulse generator, TRIDENT, has been constructed utilizing an inductive store as the primary pulse forming device. The 2.5 microh coaxial storage inductor can be energized with up to 500 kA obtained from a 500 kJ, 60 kV capacitor bank. Current interruption is accomplished using a three stage opening switch comprised of an explosively actuated switch in parallel with foil and wire fuses. The generator has been operated at the 410 kA charge level (70% energy) to produce 700 kV pulses with rise times of 150 nsec. Energy has been deposited into a 7.5 ohm resistive load at a rate of 5E10 W. Operation with optimized fuse dimensions and at full charge is anticipated to approach megavolt outputs at powers of 1E11 W. Future experiments include utilizing a homopolar generator as the current source. 7 Refs.  
Primary Keywords: TRIDENT; Explosive Fuse; Exploding Wire; Design Considerations  
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907  
USA-USSR INVESTIGATION OF 1200 KV TOWER INSULATION  
(03/1980).

912  
(PULSE GENERATORS)  
(Trigger)  
A 130 KV LOW IMPEDANCE MULTIPLE OUTPUT TRIGGER GENERATOR  
A.H. Bushnell, C.B. Dobie and A.P. Krickhuhn  
Maxwell Labs Inc, San Diego, CA 92123  
2nd IEEE International Pulsed Power Conference Proceedings, pp 161-164  
(06/1979).  
A unique low impedance trigger generator has been developed which can generate 130 kV pulses having 22 ns rise time in four 50 ohm output cables. This generator uses a multichannel rail-gap switch to discharge a group of low inductance capacitors which are charged to 150 kV into the output cables. The performance of the circuit was analyzed using a computer and successfully predicted the behavior of the circuit. Time jitter between input trigger and output pulse is less than 2 ns (one standard deviation). The unit is immersed in oil in its own metal housing. 0 Refs.  
Primary Keywords: Low Impedance; Four-output; High Voltage; Low Jitter  
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914  
(POWER CONDITIONING)  
(Pulse Transformers)  
DESIGN OF PULSE TRANSFORMERS FOR PFL CHARGING  
C.J. Rohwein  
Sandia Labs, Albuquerque, NM 87115  
2nd IEEE International Pulsed Power Conference Proceedings, pp 87-90  
(06/1979).  
Air core pulse transformers powered by low voltage capacitor banks can be simple efficient systems for charging high-voltage (0.5 to 3 kV) pulse forming transmission lines (PFL) such as those used in electron and ion beam accelerators. In these applications pulse transformers must have the combined capability of high voltage endurance and high energy transfer efficiency, particularly in repetitive pulse systems where these features are of primary importance. The design of shielded, high-voltage, spiral, strip transformers which fulfill these requirements is described in this paper. Transformers of this type have been tested in three systems which operate with greater than 90 percent transfer efficiency and have not failed in over 1E7 shots. 6 Refs.  
Primary Keywords: Air Core Pulse Transformer; Pulse Forming Lines; Charging; Strip Transformer; High Efficiency  
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916  
(SWITCHES, OPENING; SWITCHES, OPENING)  
(Mechanical; Gas)  
DEVELOPMENT OF DISTRIBUTION AND SUBTRANSMISSION SF<sub>6</sub>/SUB 6/ CIRCUIT BREAKER AND HYBRID TRANSMISSION INTERRUPTER  
G.A. Votta, R.K. Smith, M.B. Engels and L.A. Nupont  
Gould Inc, Colmar, PA 18915  
EPRI Report No. EPRI-6810 (06/1978).  
Availability: EPRI-EL-810  
EPRI  
Test models of the arc spinner interrupter were built and tested to determine the component requirements and arrangements necessary for the desired performance. A single-phase laboratory model of this interrupter was successfully tested up through 75 kA at 13.5 kV. Interruption of 40 kA at 13.5 kV was demonstrated; however, satisfactory performance was not obtained at significant current levels during this program when tested at higher voltages. A full-scale model of a three-phase outdoor distribution power circuit breaker rated 15 kA at 15.5 kV was built and successfully tested to standards. 34 Refs.  
Primary Keywords: Spinner Interrupter; Hybrid Interrupter; Vacuum Interrupter; Performance Test  
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917  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
HIGH REPETITION RATE MINIATURE TRIGGERED SPARK SWITCH  
M.F. Rose and M.J. Glancy  
Naval Surface Weapons Center, Dahlgren, VA 22448  
2nd IEEE International Pulsed Power Conference Proceedings, pp 295-300  
(06/1979).  
A miniature triggered spark switch designed to operate at high repetition rates has been constructed. The device, along with associated trigger circuitry, has been incorporated into a simple L-C generator which produces an oscillatory discharge at a frequency of 150 MHz. The switch is operated in the pressure range 760 Torr - 2.6E3 Torr using commercial dry nitrogen as the working gas. Both brass and aluminum electrodes were investigated for repetition frequency as high as 20 kHz and for gas flow rates as high as 8 cu. cm/sec. The effect of repetition rate on switch jitter and switch breakdown voltage is presented and discussed in terms of gas pressure and flow rate. 4 Refs.  
Primary Keywords: Rep-rated; High Pressure; Quenching Spark Gap; Fast Switch; Low Losses; L-C Oscillator  
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922  
(INSULATION, MAGNETIC)  
(1)

INFLUENCE OF NONUNIFORM EXTERNAL MAGNETIC FIELDS AND ANODE-CATHODE SHAPING ON MAGNETIC INSULATION IN COAXIAL TRANSMISSION LINES  
M.A. Mostron  
Los Alamos National Labs, Los Alamos, NM 87545  
2nd IEEE International Pulsed Power Conference Proceedings, pp 475-478 (06/1979)

Coaxial transmission lines, used to transfer the high voltage pulse into the diode region of a relativistic electron beam generator, have been studied using the two-dimensional time-dependent fully relativistic and electromagnetic particle simulation code CCUBE. A simple theory of magnetic insulation that agrees well with simulation results for a straight cylindrical coax in a uniform external magnetic field is used to interpret the effects of anode-cathode shaping and nonuniform external magnetic fields. Loss of magnetic insulation appears to be minimized by satisfying two conditions: (1) the cathode surface should follow a flux surface of the external magnetic field; (2) the anode should then be shaped to insure that the magnetic insulation impedance, including transients, is always greater than the effective load impedance wherever there is an electron flow in the anode-cathode gap. 7 Refs.

Primary Keywords: Numerical Calculation; CCUBE; Simple Theory;

External Magnetic Field  
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923  
(POWER TRANSMISSION; INSULATION, MAGNETIC)  
(Charge Beam Lines)

STEADY STATE NUMERICAL SOLUTION OF MAGNETICALLY INSULATED CHARGE FLOW IN COAXIAL GEOMETRY

R.J. Barker and R.F. Ottlinger  
Naval Research Lab, Washington, DC 20375  
NRL Report No. NR 4654 (11/1981)  
Availability: AD A107475

A vectorized, FORTRAN computer program has been written to calculate steady-state electron and ion fluxes as well as radial variations of the magnetic and electric fields for specific practical radial charge and magnetically insulated vacuum feed line parameters. The numerical formulation is derived in part from the theoretical treatment of the topic by K.D. Bergeron. However, it differs from the treatment in several important respects, including: a correction in one of the key scaling expressions, a restructuring of the boundary conditions to allow for specific parametric solutions, and a more careful consideration of the regions near the anode and cathode surfaces and near the electron sheath boundary. In deriving these results, analytic approximations for the fields in these 'special' regions were developed. These approximate solutions permitted numerical treatment of the singularities there. Matching the approximations between the regions also provides first-order guesses for the gross steady-state operating characteristics. 25 Refs.

Primary Keywords: Numerical Simulation; Charge Flow; Electron Flux;

Ion Flux; Radial Profile; Scaling

924  
(BREAKDOWN STUDIES)  
(Lightning)

LONG ARC SIMULATED LIGHTNING ATTACHMENT TESTING USING A 150 KW TESLA COIL

R.K. Golke  
Wendover AFB, Utah 84083  
2nd IEEE International Pulsed Power Conference Proceedings, pp 136-141 (06/1979)

Recent advances in direct lightning strike testing have been in lightning attachment test techniques and generator development using a very large Tesla Coil (51 feet wide). Breakthroughs in simulated lightning attachment to small scale replica aircraft models which can be adapted to full size operational aircraft have been made in the past year. New high voltage long arc generator developments have succeeded in producing voltages in excess of 15 million volts and arc lengths in excess of 40 feet. The shortest path from the discharge arc electrode to the model externally using the long arc does not govern the attachment points to the test specimen as it does when a short arc is used to conduct simulated lightning testing. The system just described may also have application as an ultra-high mega-volt source for particle beam weaponry. 0 Refs.

Primary Keywords: Lightning Simulation; Pulse Generator; Attachment To Aircraft

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925  
(INSULATION, MAGNETIC)  
(1)

MAGNETIC INSULATION IN SHORT COAXIAL VACUUM STRUCTURES

M.S. DiCaruso and T.S. Sullivan  
Physic International, Co. San Leandro, CA 94577  
2nd IEEE International Pulsed Power Conference Proceedings, pp 483-486 (06/1979)

Magnetically insulated vacuum structures (MIVS) can be used to overcome the limitation on power flow in liquid dielectrics and dielectric vacuum interfaces in pulsed high power accelerators. A short (1 mm), low-impedance ( $Z_{sub} \approx 50 \Omega$ ) coaxial MIVS with a gap of 5 mm was studied experimentally. Power flows of  $1.5 \times 10^4$  W/cm<sup>2</sup> were observed. The current pulse showed some erosion before the onset of magnetic insulation. The transverse electron current arising from this erosion was observed with Faraday cups imbedded in the wall. Magnetic insulation was lost about 63-70 ns into the pulse. This loss was also observed in the Faraday cups and radiation diagnostics. This loss of magnetic insulation is associated with closure of the gap by cathode plasma. 8 Refs.

Primary Keywords: Vacuum Interface; Insulation Onset; Loss; Calculation; Transverse Electron Current; Faraday Cup

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927  
(INSULATION, MAGNETIC)  
(1)

MITL-A 2-D CODE TO INVESTIGATE ELECTRON FLOW THROUGH NON-UNIFORM FIELD REGIONS OF MAGNETICALLY INSULATED TRANSMISSION LINES

E.L. Neau and C.P. Vandevender  
Sandia Labs, Albuquerque, NM 87115  
2nd IEEE International Pulsed Power Conference Proceedings, pp 479-482 (06/1979)

Self-magnetically insulated, high voltage transmission lines are used in partial confinement fusion particle accelerators to transmit power from the vacuum insulator to the diode. Injection and output convoluted sections pose special problems in establishing the desired electron flow pattern needed to maintain high overall efficiency. A time dependent, 2-D numerical code for planar or triplate geometries calculates the motion of a test electron through the tapered input or output convolutes. The 1-D parapotential model is assumed to be appropriate at each position and the magnetic field and potential distribution are calculated in the vicinity of the particle. The electric field is then calculated from Gauss's Law, and the electron motion is calculated relativistically. The results show that the electron canonical momentum in the direction of flow changes as the electron passes through a convoluted geometry. As shown by Neau, three electrons flow between the conductors after the convolute without reinterfering the cathode. We hypothesize that these electrons lead to the losses observed in long self-magnetically insulated lines. Results of calculations are correlated with results of the MITL-A experiment. 9 Refs.

Primary Keywords: Electron Flow; Convoluted Terminations; Numerical Calculation; Loss Calculation

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928  
(SWITCHES, CLOSING)

(Gas Gaps, Electrical)  
PARALLEL COMBINATIONS OF PRE-IONIZED LOW JITTER SPARK GAPS

M.A. Fitzsimmons and L.A. Rosocha  
National Research Group, Madison, WI 53705  
2nd IEEE International Pulsed Power Conference Proceedings, pp 184-186 (06/1979)

The properties of 10 to 30 kV four electrode field emission pre-ionized triggered spark gaps have been studied. A mid-plane off-axis trigger electrode is biased at  $+V_{sub} \approx 0.7$ , and a field emission point is located adjacent to and biased at the grounded cathode potential. Simultaneous application of a  $-V_{sub}$  of trigger pulse to both the electrodes results in the rapid sequential closing of the anode-trigger and trigger-cathode gaps. The observed jitter is about 1.5 ns. Parallel operation of these gaps (up to 10 so far) connected to a common capacitive load has been studied. A simple theory that predicts the number of gaps that may be expected to operate in parallel is discussed. 0 Refs.

Primary Keywords: Four Electrode Field Emission Spark Gap; Triggering Considerations; Low Jitter; Parallel Operation

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932  
(SWITCHES, CLOSING)

(Gas Gaps, Materials)  
SURFACE AGING IN HIGH REPETITION RATE SPARK SWITCHES WITH ALUMINUM AND BRASS ELECTRODES

M.J. Glency and M.F. Rose  
Naval Surface Weapons Center, Dahlgren, VA 22448  
2nd IEEE International Pulsed Power Conference Proceedings, pp 301-307 (06/1979)

The surface aging of the electrodes of miniature spark switches (A/D approximately 50) is explored using commercial dry nitrogen as the working gas. Both brass and aluminum electrodes were investigated for aging characteristics using a constant gas flow rate of 8 cu. cm. sec. The gas pressure was varied from 760 torr-5200 torr. The switches were constructed as an integral part of a miniature L-C oscillator which has a ringing frequency of approximately 150 MHz. The aging process was halted at intervals ranging from one to several thousand discharges and the electrode surface examined with a scanning electron microscope. 9 Refs.

Primary Keywords: Electrode Erosion; L-C Oscillator; Reprated; Surface Contings; Electrode Preparation

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936  
(SWITCHES, CLOSING)

(Gas Gaps, Materials)  
ACOUSTIC PHENOMENA IN EROSION OF SPARK-GAP ELECTRODES

R.A. Petr and T.R. Burkes  
Texas Tech Univ, Lubbock, TX  
Applied Physics Letters, Vol. 36, No. 7, pp 536-539 (04/1980).  
Experiments have been conducted to show that acoustic waves generated in the electrode material may cause an order-of-magnitude increase in the rate of electrode erosion. This increase is due to the arrival of reflected acoustic waves at the electrode surface while arc spots are still molten. 7 Refs.

Primary Keywords: Arc Spots; Reflected Acoustic Waves; Increased Erosion Rate

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942  
(PULSE GENERATORS; PULSE GENERATORS)

(Mark; Line Type)  
A 500 KV REP-RATE MARK GENERATOR

J. Shanher  
Mouviell Labs Inc, San Diego, CA 92123  
2nd IEEE International Pulsed Power Conference Proceedings, pp 226-231 (06/1979)

A efficient PFN/Mark generator was constructed for generating high average power electron beams. The generator consists of ten 100 kV PFN stages connected in a Mark configuration. The Marx generator employs rugged gas switches. The nominal operating parameters are: Voltage-50 kV, Current-10 kA, Pulse Duration-1 microsecond, Rep-Rate-100 Hz, Average Power-10 500 kW. This paper discusses the Marx charging power conditioning and the operation of the generator into resistive and electron beam loads. 1 Refs.

Primary Keywords: Pulse Forming Network; Marx Configuration; High Power; Gas Spark Gap; Reprated; Charging Considerations

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943  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Gas, Recovery; Gas Gaps, Recovery)  
GAS COOLING AND ELECTRIC STRENGTH RECOVERY AFTER A SPARK DISCHARGE  
E. P. Belikov  
Leningrad Polytechnical Institute, Leningrad, USSR  
Soviet Physics-Technical Physics, Vol. 16, No. 8, pp 1321-1323  
(02/1979)  
Trans. From Zhurnal Tekhnicheskoi Fiziki 41, 1678-1681 (August 1971)  
Recovery of the electric strength of air gaps with a length of 2-10 mm after the passage of current pulses of 0.6-20 kA and 3-1500 microseconds long is investigated. The cooling of the gas following a spark discharge is investigated qualitatively by means of the shadow method. 4 Refs.  
Primary Keywords: Gap Recovery; Air Gap; 20 kA Pulse; 1500 Microsecond Operation; Gas Cooling; Shadowgraph Diagnostic  
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944  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Gas, Opt. Cell; Gas Gaps, Optical)  
ELECTRON DENSITIES IN LASER-TRIGGERED SPARK GAP DISCHARGES  
R. J. Cumbley, P. R. Williams, M. A. Gundersen and A. Watson  
Texas Tech University, Lubbock, TX 79409  
2nd IEEE International Pulsed Power Conference Proceedings, pp 119-121  
(04/1979)  
The results of experiments designed to measure electron densities from measurements of Stark broadened spectral profiles in laser-triggered discharges in hydrogen are reported. Temporally and spatially resolved data have been obtained both during and after the gap for discharges in hydrogen. Evidence of a shockwave is presented, consistent with the observations of other investigators. 3 Refs.  
Primary Keywords: Stark Broadening; Laser-triggering; Hydrogen Working Gas; Shock Wave  
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950  
(PARTICLE BEAMS, ION)  
(Generation)  
HIGH-POWER ION BEAM GENERATION WITH AN INVERSE REFLEX TETRODE  
J. A. Pasour, R. A. Mohaffey, J. Golden and C. A. Kapetanakis  
Naval Research Lab, Washington, DC 20375  
Applied Physics Letters, Vol. 36, No. 8, pp 646-648 (04/1980).  
A new reflexing-electron ion source is described. The device produces a unidirectional ion beam with relatively high efficiency even when the applied magnetic field exceeds the self-field. This new source operates at a low, constant impedance during much of the applied voltage pulse and is better matched to available high-power, low-impedance generators than previous reflexing-electron devices. Proton pulses with peak current approximately 500 kA have been produced with the inverse reflex tetrode coupled to the Gamble II generator. 15 Refs.  
Primary Keywords: Reflex Triode; Low Impedance; Constant Impedance; Solid Cathode; 500 kA Output Current; Experiment; Theory  
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951  
(PARTICLE BEAMS, ION)  
(Generation)  
ION BEAM GENERATION THROUGH A MOVING PLASMA BOUNDARY  
M. Dembinski and P. K. John  
University of Western Ontario, London, Ontario, Canada  
2nd IEEE International Pulsed Power Conference Proceedings, pp 72-75  
(06/1979)  
It is shown that ion currents extracted from a moving plasma can be increased by a factor of approximately plasma velocity/acoustic speed as compared with a stationary plasma of the same density and temperature. A conical theta-pinch gun is used to accelerate plasma with density in approximately 1612 cm/sup 3/ to velocity v approximately 187 cm/s. Total currents approximately 100 A of 10-20 keV ions were obtained from an 8 cm diameter extraction system. 7 Refs.  
Primary Keywords: Moving Plasma; High Current; Child-Langmuir Law; Experiment  
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952  
(SWITCHES, CLOSING)  
(Gas Gaps, Optical)  
KRF LASER-TRIGGERED SF/SUB 6/ SPARK GAP FOR LOW-JITTER TIMING  
N. R. Renepert, J. Goldner, J. R. Murray and M. D'Addario  
Lawrence Livermore Lab, Livermore, CA 94550  
2nd IEEE International Pulsed Power Conference Proceedings, pp 236  
(06/1979)  
An SF/sub 6/ spark gap operated at field stresses of 60-180 kV/cm can be triggered with subnanosecond jitter by volume breakdown in SF/sub 6/ induced by as little as 10 mJ in 15 ns of Krf laser radiation. 0 Refs.  
Primary Keywords: Laser Triggering; Very Low Jitter  
Secondary Keywords: Abstract Only  
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954  
(BREAKDOWN STUDIES)  
(Surface Flashover)  
MECHANISM OF PULSED SURFACE FLASHOVER INVOLVING ELECTRON-STIMULATED DESORPTION  
R. A. Anderson and J. F. Brainerd  
Sandia Labs, Albuquerque, NM 87115  
Journal Of Applied Physics, Vol. 51, No. 3, pp 1414-1421 (03/1980).  
A simple model is proposed to explain how a prebreakdown avalanche of secondary emission electrons can lead to surface flashover when an insulator in vacuum breaks down a few nanoseconds after high voltage is applied. The case of a plane insulator-vacuum interface perpendicular to parallel electrodes is considered. Positive surface charging is assumed to occur almost immediately upon application of the voltage, and the attendant secondary emission avalanche is assumed to be maintained at saturation throughout the prebreakdown time delay by field emission from the cathode electrode. Bombardment of the insulator by avalanche electrons desorbs a cloud of gas, which is partially ionized as it drifts through the swarm of electrons in the avalanche. The electric field at the cathode end of the insulator becomes enhanced as positive ions accumulate, which in turn increases the field emission and the rates of gas desorption and ionization. This and other regenerative processes rapidly lead to breakdown. Field enhancement at the cathode end of the insulator and increased field emission are individually considered in determining the prebreakdown time delay, with very similar results. The proportionality we have observed between the time delay and the inverse square of the applied voltage is also predicted, as well as a dependence of the time delay on the insulator length. The model may also account for the improved performance of insulators coated with certain metal oxides. 39 Refs.  
Primary Keywords: Pulsed Surface Flashover; Prebreakdown Phenomena; Vacuum Insulator; Internal Surface; Surface Flashover; Gas Cloud  
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958  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
REPEATIVELY PULSED ELECTRON BEAM DIODE LIFETIME AND STABILITY  
M. T. Ruttram  
Sandia Labs, Albuquerque, NM 87115  
2nd IEEE International Pulsed Power Conference Proceedings, pp 61-64  
(05/1979)  
Repetitively pulsed vacuum beam diodes will be required for most projected inertially confined fusion systems. Yet data on the operation of diodes under repetitive pulsing is sparse. This paper discusses the operation of a 250 kV, 1.5 kA/qa cm diode at repetition rates to 30 Hz for sustained runs. Short term stability is typically 3 percent (standard deviation). Longer term there is a drift toward higher impedance at the start of the pulse. Details on this drift and a comparison of this process for a rather blunt versus a sharp edged cathode are presented. 1 Refs.  
Primary Keywords: Vacuum Diode; Lifetime; Impedance Stability; Reprinted  
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961  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
SIMULATION OF INDUCTIVE AND ELECTROMAGNETIC EFFECTS ASSOCIATED WITH SINGLE AND MULTICHANNEL TRIGGERED SPARK GAPS  
S. Levinson, E. E. Kucharuk, M. Kristiansen and A. H. Guenther  
Texas Tech University, Lubbock, TX 79409  
2nd IEEE International Pulsed Power Conference Proceedings, pp 433-436  
(06/1979)  
When breakdown of a pressurized spark gap is initiated by a high power laser, a narrow spark channel is quickly established. In this case, the rise time of the current in the external circuit due to the breakdown of the gap is determined in a large measure by the inductive and electromagnetic effects associated with the channel dimensions and the resulting physical discontinuities. Experiments have been conducted using spark gaps where the discharge channel is simulated by a very thin wire. Current rise time measurements for various wire sizes (i.e., spark channel radius), wire position (i.e., on or off axis), and number of wires (i.e., multichanneling) have been carried out. The rise time values thus obtained agree quite well with the laser-triggered, single and multichannel, spark gap results. These results can be qualitatively explained using simple inductive circuits which dramatically underline the inductive character of the breakdown. The significance of these results in revealing the mechanism of spark gap breakdown will be discussed. 3 Refs.  
Primary Keywords: Spark Channel Study; Simulation; Wires; Switch Inductance  
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962  
(SWITCHES, CLOSING)  
(Gas Gaps, Materials)  
SPARK GAP EROSION RESULTS  
R. Petr, D. Barrett and T. R. Burkes  
Texas Tech University, Lubbock, TX 79409  
2nd IEEE International Pulsed Power Conference Proceedings, pp 308-312  
(06/1979)  
The erosion characteristics of a spark gap with parallel-plane electrodes are determined at atmospheric and vacuum pressures. Erosion as a loss of electrode material is measured in a range from 200 to 1000 amperes. The severity of electrode erosion is found to be related to spot formation, switching rates, melting point of the electrode, pressure, and gap length. Erosion values for a pulsed current are given for aluminum, brass, and carbon. 7 Refs.  
Primary Keywords: Parallel-plane Electrodes; Low Current; Spot Formation; Switching Rate  
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968  
(SWITCHES, OPENING; BREAKDOWN STUDIES)  
(Mechanical; Vacuum; Electrical)  
THE EFFECT OF GLASS DEBRIS ON ELECTRON EMISSION AND ELECTRICAL  
BREAKDOWN OF VACUUM INTERRUPTERS  
G.A. Ferrell and F.G. Hudde  
General Electric Co., Schenectady, NY 12301  
IEEE Transactions On Electrical Insulation, Vol. EI-15, No. 2, pp 61-67  
(06/1980)

Pre-breakdown electron emission and breakdown voltages have been studied for three experimental vacuum interrupters, two of which contained numerous glass particles the largest of which were typically 50 microns in their longest dimension. The contaminated interrupters differed from the uncontaminated interrupter in the following ways: 1) Continuously recorded Fowler-Nordheim plots had lower slopes and showed several stepwise changes in emission as the applied high voltage was varied; 2) 60 Hz breakdown voltages were lower and occurred randomly for sustained AC voltage at constant peak amplitude; 3) Electron emission current with DC high voltage applied was markedly sensitive to mechanical shock. Changes in emission occurred at statistically varying time intervals which may be several tens of mill-seconds from the imposed shock. We conclude that the presence of glass particles within the interrupter strongly alters the emission properties of highly stressed internal surfaces and significantly degrades dielectric capability. 7 Refs.

Primary Keywords: Vacuum Breakdown; Glass Debris; Vacuum Interrupters; 60 Hz Breakdown Voltages; Pre-breakdown Electron Emission; Degraded Dielectric Capability; Mechanical Shock Tests; Performance Degradation  
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969  
(BREAKDOWN STUDIES)  
(Vacuum; Electrical)  
ANALYSIS AND APPLICATION OF A TRANSFORMER CORE THAT ACTS AS AN ARC  
SNUBBER  
J.M. Fink (1), W.R. Baker (2) and H.M. Owen (2)  
1) Brookhaven National Labs, Upton, NY  
2) Lawrence Berkeley Labs, Berkeley, CA  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 1, pp 33-38  
(01/1980)

A series of equations is derived from which a transformer-core arc snubber can be designed. The theories used to derive these expressions are elaborations of previous studies of pulse-operated transformer cores. Some comparisons between theoretical and experimental results are given. 6 Refs.

Primary Keywords: Arc Snubbers; Transformer Core; Eddy-current Losses; Residual Magnetization  
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973  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
A COAXIAL E-BEAM EXCITATION SYSTEM FOR HIGH POWER EXCIMER LASERS  
G.L. Oomen and W.J. Mitterman  
Twente Univ. Technology, Enschede, The Netherlands  
Optics Communications, Vol. 32, No. 3, pp 451-46 (03/1980)

The authors report operation of a medium class, high current density (237 A/sq cm) coaxial e-beam generator for excimer laser pumping. Construction is described and input and output energies are discussed. The specific input energy is found to be more than triple that of a single-sided transversal system, which is attributed to the absence of a foil support structure, a better concentration of energy, and extra electrons reflected by the potential field. 10 Refs.

Primary Keywords: E-beams; Coaxial generator; Uniform beam; Construction details; Output energy

Secondary Keywords: Excimer laser pumping  
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987  
(POWER TRANSMISSION)  
(Transmission Lines)  
HIGH POWER PULSE MODELING OF COAXIAL TRANSMISSION LINES  
J.P. O'Loughlin  
AFML, Kirtland AFB, NM 87117

2nd IEEE International Pulsed Power Conference Proceedings, pp 96-95  
(06/1979)

When coaxial cable is used for high voltage pulse transmission, a voltage transient appears on the outer sheath conductor. Although the magnitude of the transient is in the order of only a few per cent, this amounts to several kilovolts in many cases and must be carefully considered in terms of its effect on instrumentation, control and safety. To a first approximation, theoretically a coaxial cable should not develop any voltage on the outer sheath. A more refined analysis and model shows that the complete cancellation depends upon self inductance of the sheath being exactly equal to the mutual inductance between the sheath and the center conductor. This condition is never exactly satisfied due to current distribution effects, even when the distribution is uniform and radially symmetric. The situation becomes worse when proximity effects are accounted for. The predicted sheath voltage agrees with experimental data within reasonable limits. 2 Refs.

Primary Keywords: Sheath Transients; Sheath Inductance; Proximity Effects

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996  
(PULSE GENERATORS)  
(Trigger)  
LIGHT ACTIVATED 10 KV LOW JITTER PULSER  
J.D. Gelbraith  
Los Alamos National Labs, Los Alamos, NM 87545

2nd IEEE International Pulsed Power Conference Proceedings, pp 100-101  
(06/1979)

An optically activated 10 kV pulser was designed to provide low jitter, long life, reliable triggering of ignitrons, triatrons, or midplane triggered spark gaps in high voltage electrically noisy environments. For midplane triggered spark gaps, a step-up transformer is also required. The input to a fibre optic cable is a 9.5 watt injection laser diode. The pulser detects and amplifies the fibre optic cable output to 10 kV. 0 Refs.

Primary Keywords: Low Input Power; Low Jitter; High Reliability

Secondary Keywords: Pulse Transformer  
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997  
(SWITCHES, CLOSING)  
(Solid Dielectric; Optical)  
LOW JITTER, LOW INDUCTANCE SOLID DIELECTRIC SWITCHES  
A.M. Guenther, D.M. Strickland and J.R. Bettis  
AFML, Kirtland AFB, NM 87117  
The Review Of Scientific Instruments, Vol. 50, No. 11, pp 1487-1489  
(11/1979)

It has been shown that the use of graded solid dielectric sandwiches in laser-triggered spark gaps (LTS) can lead to highly desirable multichannel operations while maintaining the low delay and jitter performance characteristics of LTS. As many as ten separate breakdown channels were observed when small circular or hexagonal aluminum inserts were inserted between two Mylar dielectric sheets stressed at 4.1 kV/mil. A reduction in rise time was noted for these multichannel switching events. 7 Refs.

Primary Keywords: Solid Dielectric Switch; Laser Triggering; Multichannel Operation; Low Jitter; Low Delay

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1007  
(REVIEWS AND CONFERENCES)  
(Pav 4us)  
PULSED HIGH-CURRENT ELECTRON TECHNOLOGY  
G.A. Mesyats  
Academy of Sciences of the USSR, Tomsk, USSR

2nd IEEE International Pulsed Power Conference Proceedings, pp 9-16  
(06/1979)

The use of high-power pulse technology and explosive electron emission enables one to construct new pulsed electron devices. The present report gives the results of an intensive investigation of high-power pulse generation, electron beam geometry and the application of these beams to the production of ultra-high frequency laser and X-ray radiation. This report is based on results obtained at the Institute of High-Current Electronics. 25 Refs.

Primary Keywords: Pulse Generator; Spark Gap; Marx Generator; Module Approach; E-beam Accelerator; Rep-rated; Magnetic Insulation

Secondary Keywords: Gas Lasers

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1008  
(POWER CONDITIONING)  
(Pulse Forming Lines)  
PULSE SHARPENING IN FERRITE TRANSMISSION LINES  
M. Weiner  
ECOM, Fort Monmouth, NJ 07703

2nd IEEE International Pulsed Power Conference Proceedings, pp 91-95  
(06/1979)

Pulse sharpening effects in ferrite transmission lines may be used to obtain KV pulses with ns rise time. The exact description of the sharpening effect requires complex shock wave analysis. In this paper an approximate but useful physical model is discussed. The ferrite is treated as a lossy, bidirectional transmission line from which equivalent design results are obtained. In many instances the nonlinear effects present are confined to a region which is small compared to the total transmission length, which makes the linear approximation more plausible. Preliminary experimental results, based on a 130 cm long line, are in accord with the predictions of the model. 4 Refs.

Primary Keywords: Fast Rise Time; Theory; Lossy, Linear Transmission Line; Experiment

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1011  
(PULSE GENERATORS)  
(LC)  
HIGH REPETITION RATE LC OSCILLATOR  
S.L. Moran  
Naval Surface Weapons Center, Dahlgren, VA 22448

IEEE Transactions On Electron Devices, Vol. ED-26, No. 10 pp 1524-1527  
(10/1979)

LC oscillators have been built which can produce multi-kilowatt RF pulses in the megahertz frequency range with repetition rates of tens of kilohertz. The L and C for these oscillators can be determined from the frequency requirement and the high-Q requirements. The high repetition rates are achieved using a high-pressure spark-gap switch together with a DC to AC inverter power supply. Closely spaced antenna elements can be used to increase the number of cycles in the radiated waveforms (radiated Q). 1 Refs.

Primary Keywords: LC Oscillator; High Q; Design Considerations; Performance Test

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1049  
(ENERGY STORAGE, INDUCTIVE; PULSE GENERATORS)  
(Systems; Systems)  
NANOSECOND PULSE GENERATORS WITH INDUCTIVE STORAGE  
Yu.A. Kotov, N.C. Kolganov, V.S. Sedoi, B.M. Kovaltchuk and G.A. Mesyats  
Academy of Sciences of the USSR, Tomsk, USSR

1976 IEEE Pulsed Power Conference Proceedings, Paper 1A-1 (11/1976)

The exploding wires are used for steepening the power in LC circuit. The techniques of calculation of circuit with exploding wires is given as well as that of the calculation of the characteristics of inductive energy switching into resistive load. The high-current accelerators of electrons using this principle are also described. 39 Refs.

Primary Keywords: Inductive Energy Storage; Pulse Generator; Exploding Wire; Electron Accelerator

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1050  
(BREAKDOWN STUDIES)  
(Plasma)

PLASMA ACCELERATION IN A COAXIAL INJECTOR WITH NONCYLINDRICAL ELECTRODES DRIVEN BY AN INDUCTIVE STORAGE DEVICE

E.A. Azuev, I.V. Kichurov and M.N. Stepanenko  
I.V. Kurchatov Institute of Atomic Energy, Moscow, USSR  
Soviet Physics Technical Physics, Vol. 20, No. 9, pp 1160-1164 (09/1975).

Trans. From: Zhurnal Tekhnicheskoi Fiziki, Vol. 45, pp 1826-1833  
In experiments on plasma acceleration in a coaxial-conical injector driven by an inductive energy storage device under various conditions the peak current in the inductive storage device is 360 kA, the maximum injector current is 250 kA, and the initial pressure in the gap is varied over the range 0.1-10 Torr. Interferometer, optical probe, and electrical measurements show that at pressures 0.1-1 Torr a quasisteady contracting MHD plasma flow is established in the injector; this flow gives rise to a jet with  $n_{\text{sub}} \approx 10^{18}$  cm<sup>-3</sup> and  $v_{\text{sub}} \approx 3 \times 10^8$  cm/sec, which is focused to a cross section 2 cm in diameter. The velocity is  $1.8 \times 10^8$  cm/sec and the exit time is 5-14 nsec. The rapid current decay due to the insufficient energy stored in the storage device (30 kJ) and the mismatch between the gas injection and the flow rate in the injector leads to a localization of the discharge near the electrode insulator and to the convection of the discharge into an arc. 7 Refs.

Primary Keywords: Coaxial Injector; Non-cylindrical Electrodes; Inductive Storage; High Energy Transformation Efficiency; Plasma Jet

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1058  
(SWITCHES, OPENING)  
(Gas Gaps, Discharge)

CURRENT BREAKER WITH SPACE DISCHARGE CONTROLLED BY ELECTRON BEAM

R.M. Kovalevichuk and G.A. Mesyats  
Academy of Sciences of the USSR, Tomsk, USSR  
1975 IEEE Pulsed Power Conference Proceedings, Paper IC-7 (11/1974)  
A suggested scheme of the space discharge controlled by the electron beam should be used to break the high current. The break is made by the cessation of electron injection. The break of 150 kA current in CO/sub 2/ laser is made for the time of 200 ns. 5 Refs.  
Primary Keywords: Electron Controlled Opening Switch; Injected Thyratron; Detailed Analysis

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1060  
(BREAKDOWN STUDIES)  
(Plasma)

ELECTRIC-DISCHARGE SF/SUB 6/-H/SUB 2/ LASER PUMPED BY AN INDUCTIVE STORAGE UNIT

A.F. Zapol'skii and K.R. Yushko  
Soviet Journal of Quantum Electronics, Vol. 9, No. 2, pp 248-249 (02/1979)  
Trans. From: Kvantovaya Elektronika, Vol. 6, pp 408-411, (Feb. 1979)  
9 Refs.

Primary Keywords: Homogeneous Longitudinal Discharge; Non-polarized; SF/sub 6/-H/sub 2/ Laser; Plasma; Inductive Energy Storage

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1063  
(SWITCHES, OPENING)  
(Mechanical)

FAST-ACTING ELECTRODYNAMIC CIRCUIT BREAKER

A.A. Rudenko, F.M. Spavakova, A.M. Stokov and A.D. Frolov  
Scientific-Research Institute Of Electro-Physical Apparatus, Leningrad, USSR  
Instruments And Experimental Techniques, No. 2, pp 451-454 (04/1970)  
Trans. From: Priroda i Tekhnika Eksperimenta 2, 124-127 (March-April 1970)

A device is described which reduces the circuit breaker current to practically zero within a definite time interval, while the opening of the circuit and the restoration of dielectric strength in the breaker take place within a time shorter than that interval. Discussed are the operating principle, the construction, and the test results of a fast-acting circuit breaker which opens a circuit within 100 microseconds with a firing precision of 10 microseconds while a pulse power of 270 MW is dissipated in the resistive load. 1 Refs.

Primary Keywords: Opening Switch; 100 Microsecond Opening Time; Inductive Energy Storage; Capacitor Current Commutator

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1078  
(PARTICLE BEAMS, ELECTRON)  
(Generation)

A COMPACT PULSED ELECTRON ACCELERATOR WITH AN INDEPENDENT POWER SUPPLY

Yu.V. Afonin, A.G. Ponomarev, R.I. Soloukhin and Yu.I. Kharov  
Institute Of Theoretical And Applied Mechanics, Academy of Sciences of the USSR, Novosibirsk, USSR  
Instruments And Experimental Techniques, Vol. 16, No. 5, pp 1310-1312 (10/1975)

Trans. From: Priroda i Tekhnika Eksperimenta 5, 20-22 (September-October 1975)  
A compact pulsed electron accelerator having an independent power supply from a 12 V storage battery is described. The accelerating voltage of approximately 240 kV is formed by a pulse-voltage generator with a capacitive energy-storage device. The beam current is 4 kA. The length of a pulse is approximately 15 nsec. 8 Refs.

Primary Keywords: E-beam Generation; 15 ns Pulse Width; 240 keV Energy; 4 kA Beam Current; 12 V Primary Voltage Source

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1087  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)

A MULTISPARK HIGH-VOLTAGE TRIGATRON

V.G. Emel'yanov, B.M. Koval'chuk, V.A. Lavrinovich, G.A. Mesyats and Yu.F. Potel'tayev  
Academy of Sciences of the USSR, Tomsk, USSR  
Instruments And Experimental Techniques, Vol. 18, No. 4, pp 1114-1116 (09/1975).

Trans. From: Priroda i Tekhnika Eksperimenta 4, 89-92 (July-August 1975)

A trigatron described having a rated voltage of 400 kV and a nanosecond activation-time stability over a wide range of working voltages, which allows firing of up to eight spark channels in one discharge gap. For a commutated current of 18 nsec and a double electrical length of the shaping line equal to 130 kA more than half of the energy in the storage device is lost in the commutator in the one-spark operating regime for operation of eight channels. The energy losses in the commutator do not exceed 10% of the energy stored in the storage device. 5 Refs.

Primary Keywords: Trigatron; 400 kV Operating Voltage; Multi-channel Operation; 10% Losses; Multiple Trigger

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1090  
(SWITCHES, CLOSING)  
(Solid Dielectric, Electrical)

BREAKDOWN OF A SOLID-DIELECTRIC SWITCH

A.B. Andreev, V.A. Butsev and A.B. Produnov  
D.V. Efremov Institute, Leningrad, USSR  
Soviet Physics Technical Physics, Vol. 20, No. 2, pp 187-190 (02/1975)  
Trans. From: Zhurnal Tekhnicheskoi Fiziki, Vol. 45, pp 296-300  
An experimental study is reported of the time characteristics of a functional switch over broad ranges of working conditions. The basic dielectric material is polyethylene. A model for controlled breakdown of the solid dielectric is discussed. Qualitative and in certain cases quantitative agreement is found between the calculated and experimental data. The discrepancies are analyzed. 5 Refs.

Primary Keywords: Two Channel Switch; Time Characteristics; Polyethylene;  $I_{\text{max}} > 10^6$  A;  $d/\text{drift} > 10^{12}$  A/sec

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1095  
(PARTICLE BEAMS, ION; PARTICLE BEAMS, ION; PARTICLE BEAMS, ION)  
(Generation; Transport; Target Interactions)

THERMONUCLEAR MICRO-EXPLOSIONS WITH INTENSE ION BEAMS

F. Winterberg  
University of Nevada System, Reno, NV 89507  
Nature, Vol. 251, pp 44-46 (09/1974).

A method of generating intense ion beams using a magnetically insulated diode is presented. Theory predicts a current density of 3 kA/cm<sup>2</sup> and 1 MJ total delivered energy. Low ion velocities permit pulse shortening by time focusing. Two methods producing nuclear micro-explosions are discussed. 5 Refs.

Primary Keywords: Heavy Ion Beam; Vacuum Diode; Magnetic Insulation; Drift Tube; Spherical Symmetry

Secondary Keywords: Ion Beam Fusion

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1096  
(SWITCHES, CLOSING; POWER CONDITIONING; PARTICLE BEAMS, ELECTRON)  
(Thyratrons; Pulse Transformers; Generation)

CURRENT SWITCHING IN TESLA TRANSFORMERS

A.A. Egorov, V.S. Shukhin and S.M. Panasyuk  
Novosibirsk Institute Of Nuclear Physics, Academy of Sciences of the USSR, Novosibirsk, USSR  
Instruments And Experimental Techniques, No. 4, pp 786-789 (08/1968).

Trans. From: Priroda i Tekhnika Eksperimenta 4, 26-30 (July-August 1968)

The authors describe the results obtained from studying hydrogen thyratrons working in the current commutator of a Tesla transformer. It is shown that the commutator, which consists of antiparallel thyratrons, makes it possible to decouple the current network in the bent half-period. This makes it possible to achieve energy regeneration and increase the efficiency of a direct current accelerator using a Tesla transformer. We also consider the use of inertial (mercury) high current tubes in the energy regeneration circuit for current commutation in a high-frequency circuit, in particular, in a Tesla transformer. 5 Refs.

Primary Keywords: Thyratron Switch; Tesla Transformer; High Efficiency; Electron Accelerator

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1098  
(BREAKDOWN STUDIES)  
(Exploding Wires)

HOLOGRAPHIC INVESTIGATION OF ELECTRICAL EXPLOSIONS OF CONDUCTORS

E.A. Antonov, L.M. Gnatyuk, B.M. Stepanov, Yu.I. Filenko and V.Ya. Tsaplin  
High Temperature, Vol. 10, No. 6, pp 1087-1091 (12/1972).

Trans. From: Teplofizika Vysokikh Temperatur 10, 1210-1213 (November-December 1972)  
Holography was used to study various stages of the explosions of wires in water and air. Estimates were obtained of the fragment velocity, the shock wave velocity, and the electron density in the resultant plasma. The advantages of the holographic method over photography were identified. 6 Refs.

Primary Keywords: Hologram; Ruby Laser; Low-energy Explosion; Wire Fragmentation; High-energy Explosion; Wire Evaporation; Reconstructed Image

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1099  
(PULSE GENERATORS; SWITCHES, CLOSING; PARTICLE BEAMS, ELECTRON)  
(Review; Pulsed, Generation)

GENERATORS OF POWERFUL SUBNANOSECOND PULSES

B.M. Koval'chuk, G.A. Mesyats and V.G. Shepek  
Academy of Sciences of the USSR, Tomsk, USSR  
1975 IEEE Pulsed Power Conference Proceedings, Paper ID-5 (11/1976).  
The authors relate the switching times of spark gaps to the amount of overvoltage and rate of voltage rise. They then proceed to show how these parameters can be tailored to switch a pulse generator with subnanosecond duration. A design is then presented for an electron accelerator utilizing this pulse generator that produces subnanosecond e-beam pulses with current densities greater than 10<sup>10</sup> A/cm<sup>2</sup>. 10 Refs.

Primary Keywords: Pulse Generator; Subnanosecond Pulses; Static Breakdown; Pulse Breakdown; Very Fast Switching

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1100  
(PULSE GENERATORS; SWITCHES; CLOSING)  
(Capacitive; Gas Gaps; Self)  
HIGH CURRENT SUBNANOSECOND PULSE GENERATOR  
B. M. Koval'chuk and G. A. Mesyats  
Tomsk Polytechnic Institute, Tomsk, USSR  
Instruments And Experimental Techniques, No. 5, pp 1362-1365 (10/1970).  
Trans. From: Pribury i Tekhnika Eksperimenta 5, 102-105  
(September-October 1970)  
This paper describes the design and performance of a current pulse generator having a pulse duration of 0.6 nsec at the half-amplitude point. The pulse amplitude is continuously variable from 50 to 1000 A with repetition rates up to 1E4 Hz. The basis of the work is a study of a gas avalanche commutator. 2 Refs.  
Primary Keywords: Pulse Generator; 50-1000 A Output Current; 2 kV Charging Voltage; Switch Test; Gas Avalanche Discharge; Repetition; 10 kHz Repetition Rate  
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1105  
(PEAKDOWN STUDIES)  
(Cathode Discharge)  
HIGH-POWER, HIGH-FREQUENCY ULTRAVIOLET RADIATION SOURCE FOR PUMPING OF GAS LASERS  
A. S. Bakharev, R. C. Givens, Jr., A. M. Reshakov, and A. B. Skvortsov  
F.M. Lobachevsky Physics Institute, Academy of Sciences of the USSR, Moscow, USSR  
Soviet Journal Of Quantum Electronics, Vol. 6, No. 8, pp 994-996 (1979)  
Trans. From: Kvantovaya Elektronika, Vol. 3, pp 1824-1826 (January-February 1977)  
A continuous discharge ultraviolet radiation source was built. The length of the emitting region was 93 cm and the stored energy was up to 1 kJ. The initiation was provided by the well-known surface discharge method. The low inductance of the discharge circuit made it possible to achieve a triggering temperature exceeding 5000 degrees K in the operating region 2-3 cm from the ultraviolet pulse cathode. 1 Ref.  
Primary Keywords: Radiation Pump; Surface Discharge; Low Inductance Discharge; 5000°K Temp; Plasma; 250nm UV Pulse  
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1120  
(SWITCHES; CLOSING)  
(Gas Gaps; Electrical)  
PLASMA TRIGATRON SPARK GAP  
V. V. Baraboshkin  
Tomsk Polytechnic Institute, Tomsk, USSR  
Instruments And Experimental Techniques, Vol. 20, No. 2, pp 472-474 (04/1977).  
Trans. From: Pribury i Tekhnika Eksperimenta 2, 131-132 (March-April 1977)  
A trigatron spark gap which works at atmospheric pressure is described. The gap is capable of switching currents of up to 1E4 A over a wide range of voltages. It is shown that for breakdown voltages across the main gap of 10-15 kV, the time interval between the beginning of the trigger pulse and the beginning of the current pulse in the main circuit depends monotonically on the working voltage and may reach 30 microseconds. 5 Refs.  
Primary Keywords: Spark Gap; Trigatron Gap; 15 kV Operating Voltage; 10 kA Current; 30 Microsecond Switching Delay  
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1133  
(REVIEWS AND CONFERENCES; ENERGY STORAGE; PULSE GENERATORS)  
(Reviews; Reviews)  
TECHNOLOGY OF LARGE IMPULSE CURRENTS AND MAGNETIC FIELDS  
V. S. Komel'kov  
FID Report No. FID-MT-24-992-71 (12/1971).  
Trans. From: Tekhnika i Shikh Impul'snykh Tokov I Magnitnykh Polev. Atomizdat, Moscow, 1-472 (1970)  
Availability: AD 736910  
NTIS  
This book furnishes diagrams, calculation methods, characteristics, and designs of power capacitor batteries and their basic elements: capacitors, various types of spark gaps (vacuum, high pressure, solid dielectric), insulation of junction circuits (busbars, cables), and pulse transformers. Methods of calculating magnetic fields, as well as inductance in solenoids and conductors, are given. The design and behavior of metals in superstrong magnetic fields are examined. Orig. art. has: 205 figures, 34 tables, 268 Refs.  
Primary Keywords: Energy Storage; Capacitor; Homopolar Generator; Inductor; Switch; Spark Gap; Insulation; Design Considerations; Power Transmission

1135  
(PULSE GENERATORS)  
(Line Type)  
HIGH-VOLTAGE PULSER DEVELOPMENT  
H. Watson  
AI Research Co., Torrance, CA 90509  
IEEE Transactions On Electron Devices, Vol. ED-26, No. 10 pp 1518-1527 (10/1979).  
This paper highlights the development of a pulse generator that utilizes a single, midplane, triggered spark gap (TSG) to discharge a pulse-forming network (PFN) into a CS/sub 27 laser cavity load. The PFN is a four-section line pulser. When charged to 115 kV, it can discharge 300 J in 100 ns, full width half maximum (FWHM). The system operates at 0 to 50 pps. In designing the PFN inductors, the pulse rise time was kept long enough to avoid excessive ringing in the output cables. Such ringing can cause arcing in the cavity or damage to the cables themselves. The PFN capacitors were potted into a coaxial configuration to minimize inductance. As the pulse repetition rate increases or the charge duration decreases, special consideration must be given to design of the midplane TSG voltage grading network to ensure the trigger electrode always stays at some set fraction of the PFN voltage during charge. This paper describes a circuit that makes operation of the grading network independent of frequency and charge duration, within certain limits. Tests were run in synthetic air and in nitrogen to evaluate operating voltage and the amount of jitter and misfire as a function of pressure. 4 Refs.  
Primary Keywords: Pulse Forming Network; Spark Gap; Trigger Voltage Grading Network; Repetition; Performance Test  
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1137  
(PARTICLE BEAMS; ELECTRON; PULSE GENERATORS)  
(Generation; Blumlein Lines)  
"INFINITE" HIGH-CURRENT PULSED RELATIVISTIC-ELECTRON ACCELERATOR  
S. S. Kinoshep, G. P. Maksimov, Yu. L. Sidarov, V. P. Smirnov and A. M. Spetkov  
Instruments And Experimental Techniques, Vol. 16, No. 2, pp 364-366 (04/1973).  
Trans. From: Pribury i Tekhnika Eksperimenta 2, 26-28 (March-April 1973)  
A pulsed high-current electron accelerator having a beam current  $I = 10-30$  kA and an electron energy  $E = 0.5-1$  MeV is described. A pulse having a length of approximately 40 nsec was shaped by a Blumlein strip line in which distilled degassed water was used as the dielectric. The charging of the line was achieved by means of two standard GIN-470-0.05/5 pulse generators connected in series. 5 Refs.  
Primary Keywords: Blumlein Line; Field Emission Diode; Sliding Discharge; 1 MV Operating Voltage  
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1145  
(SWITCHES; CLOSING)  
(Gas Gaps; Electrical)  
COMBINATION OF SPARK GAPS BY MEANS OF A PULSED GAS LASER OPERATING IN THE ULTRAVIOLET RANGE  
E. A. Lasherg, Yu. V. Tkachenko, I. I. Magda, N. P. Gadetskiy and V. U. Abromovich  
Physico-Technical Institute, Academy of Sciences of the Ukrainian SSR, Kharkov, USSR  
Instruments And Experimental Techniques, Vol. 16, No. 1, pp 165-167 (02/1973).  
Trans. From: Pribury i Tekhnika Eksperimenta 16, 140-142 (January-February 1973)  
The use of a pulsed ultraviolet laser based on molecular nitrogen, which generates radiation having a wavelength 3371 angstroms and a power of 30 kW, allowed two air spark gaps to be fired at a frequency of 15 to 20 Hz. Synchronization of breakdown within at most 11 nsec was achieved. The dependences of the operate time of the spark gap on applied voltage are presented for various lengths of the spark gap for laser initiation. 3 Refs.  
Primary Keywords: Nitrogen Laser; Multiple-gap Triggering; Field Distortion; Cathode Target Electrode  
Secondary Keywords: Water Gaps  
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1146  
(SWITCHES; CLOSING)  
(Thyristors)  
CONTROLLED GAS DISCHARGE SWITCH WITH A COLD CATHODE  
G. I. Nosov and S. A. Smirnov  
Kharkov Institute Of Radioelectronics, USSR  
Instruments And Experimental Techniques, Vol. 20, No. 4, pp 1147-1149 (08/1977).  
Trans. From: Pribury i Tekhnika Eksperimenta 4, 206-208 (July-August 1977)  
A sealed-off metal-ceramic controlled gas-discharge low-pressure switch with a cold hollow metal cathode operating at a voltage of 0.4-30 kV is described. The switch is filled with H/sub 2/ at a working pressure of 0.2-0.3 torr. The device can operate in two modes in a single mode with a pulsed current of up to 30 kA, and in a frequency mode with a current of 2 kA for a frequency of the construction of the pulses of up to 100 pulses/sec. The device operating delay time is < 0.4 microseconds, and the periodic instability of this time is < 0.1 nsec. 6 Refs.  
Primary Keywords: Ion Pressure Discharge Tube; Hydrogen Gas; 30 kV Operating Voltage; 2 kA Peak Current  
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1153  
(SWITCHES; CLOSING)  
(Gas Gaps; Self)  
HIGH VOLTAGE MEGA-AMP ARC GAP WITH DESTRUCTIBLE ELECTRODES  
G. S. Vilevskiy, V. M. Karasyuk and G. I. Sil'vestrov  
Institute Of Nuclear Physics, Academy of Sciences of the USSR, Novosibirsk, USSR  
Instruments And Experimental Techniques, Vol. 21, No. 1, pp 76-79 (02/1978).  
Trans. From: Pribury i Tekhnika Eksperimenta 1, 75-77 (January-February 1978)  
Two low-inductance two-electrode arc-gap constructions of mega-amp rating are described in which one or both electrodes have the form of plates that are destroyed on passage of the current pulse. Efficient removal of electrode erosion products from the working volume of the arc gap is assured and shock loads on the stationary elements of the construction are reduced as a result. The arc gaps are filled with nitrogen to a pressure of 10-15 atm. At a working voltage of 50 kV the inductance of the arc gap does not exceed 8 nH. 3 Refs.  
Primary Keywords: Two-electrode Spark Gap; Single Shot Operation; Shot-to-shot Electrode Replacement; 50 kV Operating Voltage; 1 MA Current; 8 nH Inductance  
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1159  
(SWITCHES; CLOSING)  
(Gas Gaps; Electrical)  
NEW HIGH-POWER NANOSECOND SWITCH  
P. A. Vorob'ev, G. A. Mesyats and Yu. F. Potapitsyn  
Tomsk Polytechnic Institute, Tomsk, USSR  
Soviet Physics Technical Physics, Vol. 11, No. 8, pp 1114-1119 (02/1975).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 36, 1492-1498 (August 1966)  
A nanosecond switch has been developed which has a wide range of working voltages, a stable delay between the triggering and operating pulses, and a nanosecond switching time; it can be triggered by a pulse of small amplitude. 7 Refs.  
Primary Keywords: Spark Gap; Series-connected; Low Delay; Low Jitter; Low Trigger Voltage  
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1160  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
PRODUCTION OF AN INTENSE ELECTRON BEAM  
V. Legunov, A. Ponomorenko and L. Fomin  
Academy of Sciences of the USSR, Novosibirsk, USSR  
Soviet Physics Technical Physics, Vol. 17, No. 9, pp 1560-1567  
(1972/1973).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki, Vol. 42, No. 9, pp 1947-1957  
Experimental results are presented on the focusing of an electron beam (300 keV and 3 kA, and pulse length 10<sup>-7</sup> sec), obtained with a field-emission length cathode. The current density is 10<sup>6</sup> A/cm<sup>2</sup>. A method of measuring the beam parameters is described: These include current, electron energy spectrum, the beam configuration in the focusing magnetic field, and the total energy transported by the beam. The effect of the plasma in the accelerating gap on the operation of the vacuum diode and on beam focusing is discussed. 17 Refs.  
Primary Keywords: Focused Beam; Beam Parameter Measurements; 300keV, 3kA, 10<sup>-7</sup> Pulse Length  
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1162  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
THE TRIOTRON-A CONTROLLABLE PLASMA-CATHODE GAS-DISCHARGE DEVICE  
L.M. Vagin and L.G. Ivleva  
Instruments And Experimental Techniques, No. 6, pp 1448-1451 (12/1968).  
Trans. From: Priroda i Tekhnika Eksperimenta 6, 157-161  
(November-December 1968).  
The possibility of constructing a controlled plasma-cathode gas-discharge device, in which the electron is demonstrated experimentally. An auxiliary discharge plasma is responsible for conduct on between the working electrodes. Freedom from erosive wear of the negative working electrode facilitates the design of high-voltage devices capable of protracted service over a wide range of operating voltages. A metal-ceramic autron with a maximum operating current of 4 kA was devised. The range of autron operating voltages runs from 0.2 to 20 kV. The device is filled with hydrogen to a pressure of 0.5 torr. 6 Refs.  
Primary Keywords: Autron; Gas Discharge Switch; Thyatron-like Behavior; Hydrogen; Plasma Cathode  
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1164  
(SWITCHES, CLOSING)  
(Gas Gaps, Crossed-field)  
THE TRIOTRON-A CONTROLLABLE DEVICE WITH CROSSED FIELDS  
A.I. Vishnevskii, L.P. Pavlenko, A.I. Soldatenko and A.I. Shendakov  
Kiev Polytechnic Institute, USSR  
Instruments And Experimental Techniques, Vol. 14, No. 3, pp 847-848  
(06/1971).  
Trans. From: Priroda i Tekhnika Eksperimenta 3, 165-166 (May-June 1971).  
The possibility of creating a controllable gas-discharge device having a cold cathode and a constant magnetic field was shown experimentally. The ignition of the discharge between the main electrodes was determined by a positive potential applied to the control electrode. The cold cathode allowed powerful devices (10 to 20 kA) to be created which were capable of prolonged operation in the voltage range from 0.4 to 30 kV. The device was filled with H/sub 2/ up to a pressure of 10<sup>-2</sup> torr. 1 Refs.  
Primary Keywords: Triotron; Crossed-field Closing Switch; Electrical Starting; Low Delay  
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1167  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
ACCELERATOR MODULE OF 'ANGARA-5'  
S.V. Besenkov, O.A. Gusev, Ju.A. Istomin, Ju.V. Koba, G.M. Letmanizova, A.M. Pesechikov, P. Pavlov, V.G. Pavlov, A.S. Perlin, I.I. Rudakov, V.P. Smirnov, V.I. Chetvertkov and I.R. Jampol'skii  
I.V. Kurchatov Institute of Atomic Energy, Moscow, USSR  
2nd IEEE International Pulsed Power Conference Proceedings, pp 25-30  
(06/1979).  
Features and design principles of the inertial confinement fusion multi-module are considered. The computed output parameters of an individual module are as follows: U<sub>0</sub> = 0.8 MeV; I = 0.8 MA; 0.0 ns; W = 102 kJ. The predicted output was compared with the pulsed-shaping line rock-up measurements. According to these measurements the end on section contributes 21 percent of the total pulse-shaping line capacitor in computations via transmission line sections with appropriate impedance values. The reasonable choice of the pulse-shaping equivalent circuit was confirmed by experimental data and were in good agreement with calculations based on system design features. 9 Refs.  
Primary Keywords: E-beam Accelerator; High Voltage; High Power; Low Impedance; Modular Approach  
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1179  
(BREAKDOWN STUDIES)  
(Gas, Electric)  
CYLINDRICAL CHANNEL IN A HIGH-CURRENT DISCHARGE IN AIR  
A. Pavlovskii, G. Karlov, G. Katraev, N. Leonava and E. Smirnov  
Affiliation Not Given  
Soviet Physics Technical Physics, Vol. 20, No. 2, pp 182-186 (08/1975).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki, Vol. 45, pp 286-293  
An experimental study of high-current pulsed cylindrical discharges in air is reported. The discharge is initiated by the electrical explosion of a thin conductor; the current reaches 500 kA and the pulse length reaches 150 us. The system of magnetohydrodynamic equations with a nonlinear thermal conductivity which describes the expansion of the discharge channel is analyzed. The results of a numerical calculation for a small magnetic Reynolds number are reported. The effects of magnetic pressure and radiation diffusion on the channel expansion velocity are analyzed. It is shown that the motion of the current boundary of the channel can be simulated by the process of heat propagation through a fixed gas. This approach is used to obtain a self-similar solution for the expansion of a high-current discharge channel. 12 Refs.  
Primary Keywords: Exploding Wire; 500 kA Peak; 150us Pulse Length; High Current Discharge Channel; Heat Propagation Model  
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1186  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
ELECTRICAL BREAKDOWN OF VACUUM GAPS UNDER SUPERHIGH VOLTAGE PULSES  
I. I. Kalyutskii, G. M. Kassarov and G. V. Emirnov  
Tomsk Polytechnic Institute, Tomsk, USSR  
Soviet Physics-Technical Physics, Vol. 19, No. 11, pp 1424-1435  
(05/1973).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 44, 2326-2328 (November 1974).  
Experimental results are reported for electrical breakdown of centimeter vacuum gaps under superhigh voltage pulses. At distances up to 15 cm the breakdown field across the cathode is virtually constant, and the processes leading to the breakdown occur in short time intervals. In the microsecond time range the breakdown voltage is independent of the pressure and species of the residual gas. 4 Refs.  
Primary Keywords: Vacuum Breakdown; Very Large Overvoltage; Low Delay; 15 cm Gap; Residual Gas Effect; Voltage Measurement  
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1187  
(BREAKDOWN STUDIES; SWITCHES, OPENING)  
(Exploding Wires, Explosive Fuses)  
ELECTRICAL EXPLOSION OF FOILS. II  
V.A. Burtsev, V.N. Litunovskii and V.F. Prokopenko  
D.V. Efremov Institute, Leningrad, USSR  
Soviet Physics-Technical Physics, Vol. 22, No. 8, pp 957-961 (08/1977).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 47, 1653-1661 (August 1977).  
Experimental results on electrical explosions of foils in solid, liquid, and friable media are reported. The results are compared with data obtained in a study of explosions of foils in air. Synthetic quartz dust is found to be the most suitable of the media studied for use in microsecond foil current breakers. 7 Refs.  
Primary Keywords: Exploding Foil; Solid Environment; Liquid Environment; Synthetic Quartz Dust; Opening Switch  
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1188  
(BREAKDOWN STUDIES; SWITCHES, OPENING)  
(Exploding Wires, Explosive Fuses)  
ELECTRICAL EXPLOSION OF FOILS. I  
V.A. Burtsev, V.N. Litunovskii and V.F. Prokopenko  
D.V. Efremov Institute, Leningrad, USSR  
Soviet Physics-Technical Physics, Vol. 22, No. 8, pp 950-956 (08/1977).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 47, 1642-1652 (August 1977).  
The electrical explosion of plane foils is studied experimentally, and the results are used to formulate a mechanism for the operation of fast high-current foil current breakers. The explosions occur in air, so that optical methods can be used to observe the explosion process and the formation of the high-current shunt discharge. There are edge effects which result in dielectric breakdown of the gap and in the formation of discharge channels before the foil explosion is completed. The electrical measurements are discussed. These measurements confirm the effect of anomalous behavior in the explosion at high energy injection rates. 12 Refs.  
Primary Keywords: Exploding Foil; Opening Switch; Air Environment; Optical Diagnostics; Edge Effects; Spark Channel  
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1197  
(ELECTROMAGNETIC FIELD GENERATION)  
(Magnetic)  
HIGH PULSED MAGNETIC FIELDS FOR NUCLEAR FUEL ROD SEALING  
A.M. Andrianov, V.F. Demichev, G.A. Elisseev and P.A. Levit  
I.V. Kurchatov Institute of Atomic Energy, Moscow, USSR  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIIE-10 (11/1976).  
The technique and technology have been developed at the I.V. Kurchatov Institute of sealing the nuclear fuel rod claddings with high pulsed magnetic fields. The process of bonding the materials by magnetic pulsed sealing technique is of a dynamic character. A metal-to-metal bond is formed when a fuel rod cladding collapses at high impact velocities and impacts upon itself or onto a special plug. In this process the magnetic field serves as an energy source to accelerate the cladding. The sealing process is very short (some 70 microseconds) and the metal does not melt during the process. The main problem in the pulsed magnetic technology is the development of stable coils, which could produce with a good reproduction high pulsed magnetic field intensities of which are much higher than those necessary for fluid forming. A frequency must also be rather high because the fuel rod claddings are generally thin-walled and are made of low-conductivity materials (zirconium alloys). Capacitor banks are generally used as current generators for pulsed magnetic machines. To provide the high frequency of a discharge current the machine electrical circuit must be of a low inductance. Thus there are special requirements on pulsed magnetic machine units: capacitors, switches, busworks, and inductors. The shape of a discharge current in such machines is close to that of a damped sine wave. 9 Refs.  
Primary Keywords: Magnetic Field; High Field; Stable Coils; High Frequency; Capacitor Bank  
Secondary Keywords: Nuclear Fuel Rod Sealing  
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1207  
(SWITCHES, CLOSING)  
(Mechanical)  
MULTICHANNEL HIGH-CURRENT PULSED COMMUTATOR  
R.D. Ziganashin and A.P. Gagarin  
Instruments And Experimental Techniques, Vol. 20, No. 2, pp 475-476  
(04/1977).  
Trans. From: Priroda i Tekhnika Eksperimenta 2, 133-134 (March-April 1977).  
The compact commutator described enables one of two pulsed loads to be alternately connected to a capacitor tank. The number of power-supply channels of each load is 200 and the amplitude of the current through each channel during discharge is 10 kA. The commutator is convenient to operate and to service. 2 Refs.  
Primary Keywords: Closing Switch; Mechanical Switch; 1.5 kJ Capacitor Bank; Two Loads; Load Switching; 1.5 ns Pulse Duration  
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**1223**  
(POWER CONDITIONING)  
(Pulse Forming Lines)  
LOW-IMPEDANCE HIGH-VOLTAGE PULSERS FOR TRAVELLING-WAVE EXCITATION OF HIGH-POWER UV GAS LASERS

M.M. Von Bergemann and V. Hesson  
Optical Sciences Div. NPRL, CSIR, Pretoria 0001, South Africa  
Journal Of Physics E: Scientific Instruments, Vol. 9, pp 982-984  
(11/1976)  
The authors describe the design of a simple and novel travelling-wave-type pulsing system suitable for transverse discharge excitation of high-power UV gas lasers. The pulsers have been used to excite high-pressure nitrogen lasers at 337.1 nm with effective inversion lifetimes of 61 ns. The beam powers exceed 2 MW. 7 Refs.  
Primary Keywords: Travelling Wave Pulsar  
Secondary Keywords: Gas Laser Pumping  
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**1227**  
(ENERGY STORAGE, INDUCTIVE)  
(Systems)  
SUPERCONDUCTING INDUCTIVE ENERGY STORAGE UNIT FOR LASER PUMPING SYSTEMS  
B. Vujic, K. Keresik, B. Kopylovskii, G. Kurganov, V. Vysotskii, D. Pronkin, Y. Efremov and G. Agapov  
Academy of Sciences of the USSR, Moscow, USSR  
Soviet Journal Of Quantum Electronics, Vol. 4, No. 9, pp 1099-1101  
(03/1978)  
Trans. From: Kvantovaya Elektronika, Vol. 1, pp 1983-1987  
A description is given of a high voltage pulsed superconducting inductive energy storage unit, intended as a power supply source for laser pumping systems. 6 Refs.  
Primary Keywords: Helium Cooled Storage Element; Cryostat; Current Leads; Electrical Power Supply; Current Switching System; Gas Discharge Lamps (20kV/pulse)  
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**1246**  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Current)  
MAGNETOOPTICAL CURRENT TRANSFORMER. 2: COMPONENTS  
M. Aulich, M. Beck, M. Douklias, M. Harms, A. Papp and H. Schneider  
Siemens AG, Munchen, FRG  
Applied Optics, Vol. 19, No. 22 pp. 3735-3740 (11/1980).  
A general overview of the requirements for the components of the transformers is given. The optical fiber, the coil former, the light source, and the signal processing circuit are discussed in detail with a view towards actual devices that could be used. 16 Refs.  
Primary Keywords: Magneto-optical Current Transformers; Components; Light Source; Signal Processing; Optical Fiber  
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**1247**  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Current)  
MAGNETOOPTICAL CURRENT TRANSFORMER. 3: MEASUREMENTS  
M. Harms and A. Papp  
Siemens AG, Munchen, FRG  
Applied Optics, Vol. 19, No. 22 pp. 3741-3745 (11/1980).  
The authors describe the magneto-optical current transformer they set up. Measurements of currents were taken over a range of 50-1200 A at both room temperature and over a range of temperatures from -20 to +45 degrees Celsius. At room temperature an accuracy of 0.24% was obtained, while the accuracy was somewhat less over the range of temperatures. 4 Refs.  
Primary Keywords: Magneto-optical Current Transformer; Measurements; Very High Accuracy  
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**1248**  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
ANALYSIS OF THE ANODE BOUNDARY LAYER OF HIGH INTENSITY ARCS  
M.A. Dinulescu and E. Pfender  
University of Minnesota, Minneapolis, MN  
Journal Of Applied Physics, Vol. 51, No. 6, pp 3149-3157 (06/1980).  
A one-dimensional analysis of the anode boundary layer of an atmospheric pressure, high intensity argon arc reveals substantial deviations from local thermodynamic equilibrium (LTE) in this layer. The temperature of the heavy species approaches the temperature of the anode in the immediate vicinity of the anode surface, whereas the electron temperature remains sufficiently high to ensure the required electrical conductivity. Temperature and density gradients in the anode boundary layer contribute substantially to the electric current flow so that the potential drop across the boundary layer becomes negative. The main voltage drop, which is in the order of 1 V, is essentially confined to the sheath at the bottom of the boundary layer overlying the anode surface. The thickness of this sheath is several orders of magnitude smaller than the anode boundary layer and the potential drop in the sheath is also negative. Therefore, the anode fall becomes negative for the entire parameter range covered in this paper. In contrast to the results of previous theories, this finding affects the anode energy balance as well as the interpretations of indirect (calorimetric) anode fall measurements which is important for the design of arc gas heaters. 17 Refs.  
Primary Keywords: Argon Arc; Boundary Layer; Negative Potential Drop  
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**1252**  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
MODELING OF THE ANODE CONTRACTION REGION OF HIGH INTENSITY ARCS  
D.M. Chen and E. Pfender  
University of Minnesota, Minneapolis, MN  
IEEE TRANS PLAS SCI, Vol. PS-8, No. 3, pp. 252-259 (09/1980).  
A self-consistent model for the anode contraction region of a high intensity DC arc is based on a well stabilized axisymmetric arc operated at atmospheric pressure with a plane cooled nonablating anode perpendicular to the arc axis. Arc contraction in front of the anode gives rise to an entrainment of cold gas from the vicinity of the anode leading to a more or less pronounced anode jet. The conservation equations for the anode region represent a set of highly nonlinear integro-differential equations which describe the temperature and the flow field in the arc. Numerical solutions of these equations are obtained by using an iterative finite-difference method. Results for a nitrogen arc at 250 A indicate that heat transfer close to the anode is dominated by the electron enthalpy transport. The cold gas approaches the arc fringes with velocities in the order of 1 m/s, and reaches velocities of up to 250 m/s in the hot core of the arc, indicating the existence of an anode jet which has been confirmed by experimental investigations. 16 Refs.  
Primary Keywords: Temperature; Arc Flow Field; Self-magnetic Field  
Secondary Keywords: Numerical Results; Boundary Conditions; Potential Profile  
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**1253**  
(PARTICLE BEAMS, ION)  
(Reviews)  
NRL LIGHT ION BEAM RESEARCH FOR INERTIAL CONFINEMENT FUSION  
G. Cooperstein, S. Goldstein, D. Mosher, R.J. Barker, J.R. Boller, D.G. Colombant, A. Drobot, R.A. Magor, W.F. Oliphant, P.F. Ottinger, F.L. Sandel, S.J. Stephanakis and F.C. Young  
Naval Research Lab, Washington, DC 20375  
NRL Memorandum Report No. 4387 (11/1980).  
Availability: AD A92471  
NTIS  
There is presently great interest in using light ion beams to drive thermonuclear pellets. Terawatt-level ion beams have been efficiently produced using conventional pulsed power generators at Sandia Laboratory with magnetically-insulated ion diodes and at the Naval Research Laboratory with pinch-reflex ion diodes. Both laboratories have recently focused ion beams to pellet dimensions. This paper reviews recent advances made at NRL in the area of ion production with pinch-reflex diodes, and in the areas of beam focusing and transport. In addition, modular generator and beam transport systems for pellet ignition systems are reviewed and compared with the latest experimental results. These results include the following: (1) production of greater than 100 kJ proton and deuteron beams with peak ion powers approaching 2 TW on the PITHON generator in collaboration with Physics International Co., (2) focusing of 0.5 TW deuteron beams produced on the NRL Gamble II generator to current densities of about 300 kA/sq. cm., and (3) efficient transport of 100 kA level ion beams over 1 meter distances using Z-discharge plasma channels. 28 Refs.  
Primary Keywords: Intense Light Ion Beams; Ion Beam Focusing; Ion Beam Transport  
Secondary Keywords: Inertial Confinement Fusion; Charged Particle Beam Fusion

**1255**  
(PARTICLE BEAMS, ELECTRON)  
(Target Interactions)  
RADIATION FROM RELATIVISTIC ELECTRONS IN A MAGNETIC WIGGLER  
A.N. Didenko, A.V. Kozhevnikov, A.F. Medvedev, M.M. Nikitin and V.Ya. Epp  
Tomsk Polytechnic Institute, Tomsk, USSR  
Soviet Physics JETP, Vol. 49, No. 6, pp 973-979 (06/1979).  
Trans. From: Zh. Eksp. Teor. Fiz. 76, 1919-1932 (June 1979)  
The spectral and polarization properties of wiggler radiation of relativistic electrons have been investigated theoretically and experimentally as a function of angle in the optical region of the spectrum for motion of the electrons in a plane magnetic wiggler installed in the ring of an electron synchrotron. The properties of the first and second harmonics of the radiation are discussed. It is shown that the polarization-angular characteristics of the first harmonic of the wiggler radiation coincide with those of the resonant synchrotron radiation; the influence of longitudinal oscillations of the electron in the wiggler on the polarization properties of the second harmonic radiation is also shown. The appreciable influence of the angular spread of the electrons in the beam on the spectral-angular distribution of the wiggler radiation is established experimentally. The good agreement of the experimental results with the theory opens up the possibility of further use of wiggler radiation for solution of a wide range of scientific and applied problems. 32 Refs.  
Primary Keywords: Relativistic E-beam; Magnetic Wiggler; Spectral Properties; Polarization; Theory; Experiment  
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**1257**  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Data Transmission)  
DEMONSTRATION OF FIBER OPTIC LINK APPLICATIONS IN UTILITY PLANT MULTIPLEXED INSTRUMENT AND CONTROL SYSTEMS  
W.D. Redus, G.R. Cravo and W.J.B. Oldham  
E-Systems, Inc., Greenville, TX 75041  
EPRI Report No. EPRI NP-1322 (01/1980).  
Availability: EPRI NP-1322  
EPRI  
The application of data transmission via fiber optic cables has been demonstrated at a utility instrumentation plant at the Bergen Generating Station operated by Public Service Electric and Gas Company (PSE&G) of Newark, N.J. The fiber optic system (FOS) was designed, fabricated, and tested by E-Systems, Inc., Greenville Division, located in Greenville, Texas, using commercially available components. Plastic fiber optic cables were evaluated for short run applications up to 140 feet and glass fiber optic cables were evaluated for long run applications up to 1330 feet. The FOS and fiber optic cables were installed, operated and maintained by PSE&G's technicians under the management of PSE&G with technical input from E-Systems, Inc. The demonstration was conducted over a ten month period.  
Primary Keywords: Fiber Optics; Instrumentation; Control; Electromagnetic Interference; Multiplex  
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1258  
(ENERGY CONVERSION, THERMAL)  
(Magnetohydrodynamic)  
HIGH POWER MAGNETOHYDRODYNAMIC SYSTEM (VOL II)  
D.M. Swallow, O.K. Schu, D.E. Header and H. Becker  
Maxwell Labs Inc. Woburn, MA 01801  
AFAPL Report No. AFAPL-TR-78-51 (07/1978).  
Availability: AD A064435  
NTIS

The technical effort discussed in this report covers Phase B of the High Power Magnetohydrodynamic System program, which is a multi-phase program to develop liquid oxygen/liquid hydrocarbon magnetohydrodynamic generators using cesium seed for high performance, portable power supply applications. During this phase a lightweight, high performance hot gas flow train using liquid oxygen and JP-4 was designed and component modeling completed. The magnetohydrodynamic channel/diffuser performance parameters which were used as the design criteria were an output power of 30 MWe, a specific energy extraction of 1.0 MJ/kg, and a specific power density of 200 MWe/cu. m. To achieve these performance requirements, the required characteristic velocity efficiency of the combustion system was greater than 99%. During this program a limited amount of development testing was completed using a heat sink combustor and a diagnostics channel. These tests measured the combustor characteristic velocity efficiency and the gas electrical conductivity, as well as pressures, vibrations, and temperatures. The results of the development test program, which verified the design assumptions used to achieve the performance requirements, were a characteristic velocity efficiency of nearly 99% and a gas electrical conductivity at the magnetohydrodynamic channel inlet of 15 mhos/m. 50 Refs.

Primary Keywords: Portable Power Supplies; MHD Generators; Fast Start Power Supplies; Compact MHD Generator; Burst Power Supplies; High Performance MHD Generator; Flightweight MHD; Lightweight Megawatt Power Supplies; Cesium Seeding of MHD Gases; JP-4 Fueled MHD

1259  
(ENERGY CONVERSION, THERMAL)  
(Magnetohydrodynamic)  
HIGH POWER MAGNETOHYDRODYNAMIC SYSTEM (VOL I)  
D.M. Swallow, O.K. Schu, D.E. Header and H. Becker  
Maxwell Labs Inc. Woburn, MA 01801  
AFAPL Report No. AFAPL-TR-78-51 (07/1978).  
Availability: AD A064795  
NTIS

The technical effort discussed in this report covers phase B of the High Power Magnetohydrodynamic System program, which is a multi-phase program to develop liquid oxygen/liquid hydrocarbon magnetohydrodynamic generators using cesium seed for high performance, portable power supply applications. During this phase a lightweight, high performance hot gas flow train using liquid oxygen and JP-4 was designed and component modeling completed. The magnetohydrodynamic channel/diffuser performance parameters which were used as the design criteria were an output power of 30 MWe, a specific energy extraction of 1.0 MJ/kg, and a specific power density of 200 MWe/cu. m. To achieve these performance requirements, the required characteristic velocity efficiency of the combustion system was greater than 99%. During this program, a limited amount of development testing was completed using a heat sink combustor and a diagnostics channel. These tests measured the combustor characteristic velocity efficiency and the gas electrical conductivity, as well as pressures, vibrations, and temperatures. The results of the development test program, which verified the design assumptions used to achieve the performance requirements, were a characteristic velocity efficiency of nearly 99% and a gas electrical conductivity at the magnetohydrodynamic channel inlet of 15 mhos/m. 50 Refs.

Primary Keywords: Portable Power Supplies; MHD Generators; Fast Start Power Supplies; Compact MHD Generator; Burst Power Supplies; High Performance MHD Generator; Lightweight Megawatt Power Supplies; Cesium Seeding Of MHD Gases; JP-4 Fueled MHD

1260  
(SWITCHES, CLOSING)  
(CLASS)  
LIGHT-FIRED THYRISTOR DEVELOPMENT  
E.S. Schlegel, E.C. Strycula and L.R. Lowry  
Westinghouse Electric Corp. Pittsburgh PA  
EPRI Report No. EPRI EL-1916 (07/1981).  
Availability: EPRI EL-1916  
EPRI

A light-fired thyristor switch was demonstrated in one phase of a static volt-ampere-reactive generator and is presently under extended test at Minnesota Power and Light Company. The building of this 13.8-kV, bidirectional, 1200-A rms, solid-state switch required the development of the thyristor element and its special package, a light system consisting of laser diodes and a light distribution harness, and a special monitoring and protecting control circuit to protect the switch against various conditions under which it might not function safely. The switch is entirely self-contained and replaces the electrically gated version with no need for changes in the circuit to which it is connected. The report gives details on the development of each of the novel parts of the system: on the testing of each part of the system; and on the building, installation, and early evaluation of the switch. 0 Refs.

Primary Keywords: Thyristor; Optical Triggering; Bidirectional; Performance Test  
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1261  
(INSULATION, MATERIAL; BREAKDOWN STUDIES)  
(Liquid; Liquid; Electrical)  
HIGH-VOLTAGE OIL GAP TESTS USING PARALLEL-PLANE ELECTRODES  
T.K. Sloat, W.J. Carter and H.R. Moore  
Westinghouse Electric Corp. Sharon, PA 16146  
EPRI Report No. EPRI EL-1301 (12/1979).  
Availability: EPRI EL-1301  
EPRI

A paraffinic-base insulating oil, PB, and a naphthenic-base insulating oil, NH, were evaluated using two electrode systems. The uniform field electrodes represented a method to easily test relatively large volumes of oil and showed the paraffinic-base oil, PB, had somewhat lower breakdown voltages on both 60-Hz tests and 1.2-X 50-microsecond impulse voltage tests. The rod to plane electrode system represented a more practical configuration that may occur in oil insulated apparatus and showed there was no substantial difference between the oils on the 60-Hz tests. The impulse tests on the rod to plane test showed the paraffinic-base oil had a higher dielectric strength than the naphthenic-base oil. The routine daily dielectric breakdown voltage tests using ASTM D1816 showed the paraffinic-base oil had a higher dielectric strength than the naphthenic-base oil. Since the uniform field tests made with larger volumes of oil indicated a possible weakness in the paraffinic-base insulating oil, it is not acceptable for use in electrical apparatus. 0 Refs.

Primary Keywords: Oil; Paraffinic; Transformers; Naphthenic; Breakdown Strength  
Secondary Keywords: Circuit Breakers  
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1263  
(ENERGY CONVERSION, ELECTRICAL)  
(Power Supplies)  
A 10 KW LIGHTWEIGHT DC CONVERTER (TECHNOLOGY FEASIBILITY STUDY FOR LIGHTWEIGHT MEGAWATT RANGE CONVERTERS)  
F.C. Schwarz  
Power Electronics Associates, Inc., Lincoln, MA 01773  
AFAPL Report No. AFAPL-TP-77-45 (11/1977).  
Availability: AD A049937  
NTIS

The technology for an ultra-reliable, lightweight, high power DC converter is presented and supported by test data of a small 10 kW feasibility model. Reliability and a high efficiency near 97 percent are derived from a process of natural current commutation of fast switching thyristors in series resonant circuits. Lightweight is the result of an internal frequency near 10 kHz. The feasibility of 150 kW single modules with one set of thyristors is indicated. The salient features of this converter technology are highlighted. 17 Refs.

Primary Keywords: 10kW, 100kW, Submegawatt, Megawatt; High Voltage DC Supply; Natural Current Commutation; Series Resonant Circuit Power Converter; High Power Conditioner; Power Converters; Highly Reliable; Secondary Current Source

1264  
(ENERGY CONVERSION, ELECTRICAL)  
(Power Supplies)  
DEVELOPMENT OF LIGHTWEIGHT TRANSFORMERS FOR AIRBORNE POWER SUPPLIES  
J.P. Walsh  
Thermal Technology Lab, Inc., Buffalo, NY  
AFAPL Report No. AFAPL-TR-79-2049 (06/1979).  
Availability: AD A076245  
NTIS

Emphasis on this program was on the development of high voltage, high power, high frequency, low specific weight, inverter transformers. A primary intent was on the reduction of specific weight without sacrifice of either electrical performance or reliability. Research was conducted into the characteristics of magnetic and dielectric materials, improved magnetic circuit modeling, and application of advanced heat transfer techniques. Computer-aided design methods were utilized and specialized programs were developed to permit extensive manipulation of multiple design parameters. One goal, to achieve a specific weight of 0.25 lb/KVA, was exceeded. A specific weight of about 0.10 lb/KVA was actually accomplished with a 200 KVA transformer. It is predicted that in larger transformer sizes, specific weights of 0.07 lb/KVA can be realized. The other goals of electrical performance and reliability were also achieved. The inverter transformers developed in this program exhibited unusually low leakage inductance and high efficiency. Higher reliability than conventional transformers should also be realized due to much lower operating temperatures (ie: lower thermal stress) on conductors and insulation. The program has been successfully concluded and two basic transformer/rectifier unit designs (two each at 10 KW and 200 KW) were fabricated, demonstrated and delivered. 10 Refs.

Primary Keywords: Low Specific Weight Transformers; High Energy Density Transformers; Inverter Transformers; High Frequency Transformers  
Secondary Keywords: Airborne Transformers; Lightweight Transformers

1265  
(BREAKDOWN STUDIES)  
(Gas; Optical)  
A CW X-RAY PREIONIZER FOR HIGH-REPETITION-RATE GAS LASERS  
T. Arai, M. Obara and T. Fujioke  
Keio University, Kohoku-ku, Yokohama-shi, Japan  
APPL PHYS LETT, Vol. 36, No. 4 pp. 235-237 (02/1980).

Operation of a cw x-ray preionizer for an HF laser is reported. An industrial x-ray tube was used to introduce soft x-rays into a laser chamber. Arcing was seen to be suppressed by the cw x-ray preionizer. The advantages of the cw preionizer over a flash preionizer are discussed, along with the possible application of a cw preionizer to high repetition rate lasers. 10 Refs.

Primary Keywords: X-ray Preionization; Continuous Wave  
Secondary Keywords: X-ray Laser; High Rep-rate  
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1266  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Current)  
ELECTRONIC CURRENT TRANSDUCER (ECT) FOR HIGH-VOLTAGE DC LINES  
J. M. Houston, P. H. Peters Jr., M. R. Summerhays Jr., G. J. Carlson and  
A. M. Tiant  
General Electric Co., Schenectady, NY 12301  
EPRI Report No. EPRI EL-1343 (02/1980).  
Availability: EPRI EL-1343  
EPRI

This report deals with the development of a bipolar electronic current transducer (ECT) for measuring the current in a high-voltage DC (HVDC) power line at line potential. The design and construction of a free-standing ECT for use on a 400-kV line having a nominal line current of 2000 A (1 pu) is described. Line current is measured by a 0.001 ohm shunt whose voltage output is sampled by a 16-bit digital data link. The high-voltage interface between line and ground is traversed by optical fibers which carry digital light signals as far as 300 m to a control room where the digital signal is converted back to an analog representation of the shunt voltage. The redundant electronic and optical data links are used in the prototype. Specification goals called for operation over the temperature range -40 to +50 Deg. C to an output accuracy of  $\pm 0.6\%$  at 0.1 pu and  $\pm 0.3\%$  between 0.3 pu and 1.0 pu. A frequency response greater than 370 Hz and a step response time of less than 2 ms was desired. Initial tests indicate that these goals have been met in the prototype structure. The unit is now installed and being evaluated at the Sylmar converter station of the HVDC Pacific Intertie in California. 0 Refs.

Primary Keywords: HVDC; Electronic Transducers; Current Measurement; Fiber Optic Link  
Secondary Keywords: Current Transducer  
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1267  
(BREAKDOWN STUDIES; SWITCHES; OPENING)  
(Gas; Recovery; Mechanical)  
FUNDAMENTAL INVESTIGATION OF ARC INTERRUPTION IN GAS FLOWS  
D. M. Benenson (1), G. Frind (2), R. E. Kinsinger (2), H. T. Nagamatsu (2), H. O. Noeske (2) and R. E. Sheer Jr. (2)  
(1) State University of New York at Buffalo, Buffalo, NY 14226  
(2) General Electric Co., Schenectady, NY 12301  
EPRI Report No. EPRI EL-1455 (02/1980).  
Availability: EPRI EL-1455  
EPRI

The document reports on continuation of the study of thermal recovery in gasblast interrupters reported earlier in EPRI Report EL-284. The thermal recovery process was investigated with physical and aerodynamic methods, typically using reduced size nozzles and short sinusoidal current pulses. Current-zero di/dt and gas pressures were representative of full-size interrupters. Aerodynamic characterization of the cold flow fields in several different nozzle types included measurements of the pressure and flow fields, both steady-state and turbulent components, with special attention given to wakes and shock structures. Special schlieren techniques on DC arcs and high-speed photography on arcs in orifice nozzles show that shock heating broadens the arc independent of turbulence effects and producing a poorly recovering downstream arc section. Measured recovery speeds (RRRV) in both orifice and convergent-divergent nozzles agree with predictions of several arc theories assuming turbulent power losses. However, data on post-zero currents and power loss show values much smaller than theoretical predictions. Hydrogen, deuterium, and methane (H/sub 2, D/sub 2, CH/sub 4) were measured to have thermal recovery speeds up to one hundred times that of SF/sub 6 in the same conditions. Mixtures of AF/sub 6 with CF/sub 4, C/sub 2F/sub 4, F/sub 2, He, or H/sub 2 can give fast thermal recovery when used at high total pressure but moderate SF/sub 6 content. 21 Refs.

Primary Keywords: SF/sub 6; Thermal Recovery  
Secondary Keywords: Circuit Breakers; Gas-Blast Interrupters  
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1268  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Miscellaneous)  
SF/SUB 6/ DIELECTRIC FILL GAS GAUGE  
R. Bell, R. Mickstad, J. VanVleet and M. Bertin  
Nucleonic Data Systems Inc., Irvine, CA 92714  
EPRI Report No. EPRI EL-1747 (04/1978).  
Availability: EPRI EL-1747  
EPRI

The use of SF/sub 6/ gas-insulated equipment in substations is gaining wide acceptance. For reliable operation of this type of equipment, it is important that the gas density be maintained within design limits and that the gas not be contaminated. It is therefore of interest to have a gauge that can be used for continuous monitoring of the gas. Such a gauge should be able to detect leaks in excess of 1-2% per year as well as detect gas contaminants of significant levels. This project has shown that it is feasible to directly measure the density of the SF/sub 6/ gas, as well as measure the gas humidity. The prototype gauge, however, is rather complex and most likely would be more expensive than the conventional pressure gauges. The experimental gauge that has been developed uses the infrared absorption characteristics of the gases. A wavelength is chosen where the monitored gas absorbs strongly, but where interference from other gases is minimal. The photon absorption is approximately proportional to the density of the gas, which is also proportional to the dielectric strength of the gas. 26 Refs.

Primary Keywords: Photo-optic Pressure Gauge For SF/sub 6/ Gas; Infrared Light Absorption For SF/sub 6/ Gas; Infrared Light Absorption Of Water Vapor; Infrared Light Absorption Of SF/sub 6/ Gas Decomposition Products  
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1271  
(BREAKDOWN STUDIES)  
(Surface Flashover)  
MECHANISM OF FAST SURFACE FLASHOVER IN VACUUM

R. A. Anderson  
Sandia Labs., Albuquerque, NM 87115  
Applied Physics Letters, Vol. 2, No. 2, pp. 54-56 (08/1973).  
Insulator samples of Plexiglas and alumina ceramic in vacuum have been subjected to high-voltage pulses with rise times of a few nanoseconds. Breakdown paths were inclined to the electric field in the presence of a magnetic field normal to the insulator surface, analogous to the Hall effect for bulk conduction. These results, as well as measurements of the flashover propagation velocity, strongly support a model of the flashover mechanism based on secondary electron emission. 9 Refs.

Primary Keywords: Surface Flashover; Vacuum; Plexiglas; Alumina Ceramic; Short Pulse Flashover; Secondary Electron Emission  
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1272  
(PARTICLE BEAMS, ION; PARTICLE BEAMS, ELECTRON; PARTICLE BEAMS, NEUTRAL; POWER TRANSMISSION; ENERGY STORAGE, CAPACITIVE)  
(Reviews; Reviews; Transmission Lines; Marx Generators)  
PARTICLE BEAM FUSION PROGRESS REPORT OCTOBER 1977 THROUGH MARCH 1978  
Sandia Labs., Albuquerque, NM 87115  
Sandia Report No. SAND79-0002 (02/1979).  
Availability: SAND79-0002  
NTIS

Important data showing the transport of electrical power in the narrowest range over 6.5 meters with a power transport efficiency of 100 percent and an energy transport efficiency of 90 percent were obtained. These results were required for EBFA and demonstrated the feasibility of the vacuum interface, magnetically insulated line, and diode concept. The results exceeded expectations and provided a 2 ns rise from zero to peak of a 0.4 MA current. Magnetically insulated power flow densities exceeding 1E11 W/cm<sup>2</sup> were achieved over shorter distances. These results indicate that a much smaller beam drift distance to the pellet could be possible. Although about 50 percent of the electron current flows external to the conductor boundary during the 6.5 meter transport, all of the current was recaptured and most was focused to a few nm spot during these experiments. 25 Refs.

Primary Keywords: Pulse Forming Lines; Marx Generator  
Secondary Keywords: Trigonon Switch; Intermediate Storage Capacitor; Gas Pressure Transducer

1273  
(ENERGY STORAGE, MECHANICAL)  
(Rotating Machines)  
APPLICATION OF GENERATOR ANALYSIS METHODS

R. Kuhler  
University of Kentucky, Lexington, KY 40506  
AFAPL Report No. AFAPL-TR-77-31 (04/1977).  
Availability: AD A042071  
NTIS

This study provides a theoretical model for simulating a wide variety of transient loading conditions for alternators. The model is represented as an equivalent circuit in a format compatible with the SCEPTRE computer program. SCEPTRE solves the resulting circuit equations for the transient response. Also addressed in this study is the inclusion of an effective saturation property into the SCEPTRE formulation resulting in a more realistic, and accurate nonlinear machine model. 2 Refs.

Primary Keywords: SCEPTRE Simulation; Alternator Modeling; Saturation Effects; Linear Machine Model

1274  
(ENERGY CONVERSION, ELECTRICAL)  
(Power Supplies)  
DEVELOPMENT OF LIGHTWEIGHT TRANSFORMERS FOR AIRBORNE HIGH POWER SUPPLIES  
D. L. Lockwood, R. L. McNeil Jr. and R. L. Houmesier  
Thermal Technology Lab, Inc., Buffalo, NY  
AFAPL Report No. AFAPL-TR-76-102 (12/1976).  
Availability: AD A04515  
NTIS

Several major developments have occurred in this program. As is often the case in research, they did not occur exactly in accordance with the original plan. The total program however is essentially on schedule. New techniques for fabrication of pie wound transformers were developed which yielded superior designs. This development was followed by the development of computer aided design programs for pie wound transformers. Several 10 KW transformers have been fabricated and subjected to a variety of tests. Based on the results of these tests both the 10 KW and 200 KW transformers will be pie rather than layer wound. A 10 KW transformer rectifier system is presently being integrated with a breadboard inverter for final verification. During the first half of this program, a numerical method was developed for the solution of the nonlinear lumped parameter transformer model. This model was developed under the previous contract, but no stable solution had been found. The present solution is for a resistive load and work is continuing to include leakage inductance, shunt capacitance, and transformer load impedance. The major task is studies support of the 200 KW transformer task are completed with execution of evaluation of some of the newer fluorine based dielectric fluids. Preliminary designs indicate specific weights in the neighborhood of 0.05 lb/KVA for these transformers. 9 Refs.

Primary Keywords: Low Specific Weight Transformers; High Voltage, High Power Transformers; Airborne Transformers; Lightweight Transformers  
Secondary Keywords: Airborne Transformers; Lightweight Transformers

1275  
(ENERGY STORAGE, INDUCTIVE)  
(Inductors)  
INDUCTOR NETWORK DEVELOPMENT FOR AIRCRAFT HIGH POWER SUPPLIES  
J. Tene, R. L. Bryan, S. Ghoshroy, L. M. Lantai and O. K. Sonju  
Maxwell Labs Inc., Woburn, MA 01801  
AFAPL Report No. AFAPL-TR-77-15 (04/1977).  
Availability: AD A052750  
NTIS

This report presents the results of a study program undertaken to perform a comparative analysis of several approaches to the generation of high electrical power by storing tens to hundreds of kilojoules of energy in a compact, superconducting inductive system with efficient extraction in short bursts at high repetition rates. The critical factors for the comparison were the weight, volume, dissipation and reliability of the system and components for various operating regimes characterized by pulse power, repetition rate and pulse shape. Research and development work hitherto undertaken in the U.S. and abroad indicate the engineering feasibility of operating inductive storage systems storing ten to perhaps one hundred kilojoules of energy with extraction rates of tens of pulses per second at pulse durations of the order of a few hundred microseconds with state-of-the-art technology. The major effort of this study was directed towards developing analytical tools to predict the performance of superconducting coils at repetition rates of 100 -1000 ops with pulse discharge times of 20 - 40 microseconds and to evaluate the relative merits of different circuit configurations for storage and extraction of energy at high average power (3 - 10 MW). 0 Refs.

Primary Keywords: Inductive Energy Storage; Superconductivity; Pulsed Power  
Secondary Keywords: Power Conditioning

1277  
(REVIEWS AND CONFERENCES; POWER CONDITIONING; SWITCHES, CLOSING;  
SWITCHES, OPENING; POWER TRANSMISSION; ENERGY STORAGE, MECHANICAL;  
ENERGY STORAGE, CAPACITIVE; ENERGY STORAGE, INDUCTIVE; PULSE  
GENERATORS)

(Reviews; Reviews; Reviews; Reviews; Reviews; Reviews; Reviews;  
Reviews; Reviews)  
LECTURES ON HIGH-VOLTAGE AND PULSE POWER TECHNOLOGY; LECTURE 1:  
INTRODUCTION TO POWER CONDITIONING SYSTEMS

W.J. Sargeant  
Los Alamos National Labs, Los Alamos, NM 87545  
LASL Report No. LA-UR-80-515 (10/1980).  
Availability: LA-UR-80-515

LASL  
This lecture provides a definition and tutorial overview of power conditioning systems. Many specific examples of energy storage systems are discussed, along with pulse forming techniques. Definitions are given for several pulse parameters with justification for each included. Problems with pulse shaping, ringing, crosstalk, and switch recovery are discussed. Several types of switches are discussed, including ignitrons, thyratrons, and spark gaps. As well as hard tube switches and power conditioning systems. Pulse transformers are also briefly discussed. This lecture is designed as an introduction to the series, with most topics discussed in greater detail in other lectures. 1 Refs.

Primary Keywords: Ignitron; Thyatron; Spark Gap; Pulse Forming Network; Rep Rated; Hard Tube; Pulse Transformer  
Secondary Keywords: Charging Circuit; Overshoot; Peak Power; Loads

1278  
(ENERGY CONVERSION, ELECTRICAL; PULSE GENERATORS; INSULATION, MATERIAL)  
(Power Supplies; Hard-tube; Reviews)  
LECTURES ON HIGH-VOLTAGE AND PULSE POWER TECHNOLOGY; LECTURE 2: DC  
POWER SUPPLIES AND HARD-TUBE POWER CONDITIONING SYSTEMS

W.J. Sargeant  
Los Alamos National Labs, Los Alamos, NM 87545  
LASL Report No. LA-UR-80-515 (10/1980).  
Availability: LA-UR-80-515

LASL  
This lecture discusses the major characteristics of DC power supplies and hard-tube pulsers. Full-wave bridge rectifier circuits are discussed in detail, with a complete analysis of operation presented. Design criteria pertaining to high voltage diode stacks are presented with a summary of pitfalls inherent to the stacks. Included insulation for these high voltage supplies is discussed. A detailed conceptual discussion of hard-tube pulsers is also presented with a brief mathematical analysis included. 8 Refs.

Primary Keywords: Power Supply; Hard-tube Pulser; Rectifier Circuit; Diode Stack  
Secondary Keywords: Insulation; Transformer; Filter; Multi-phase

1279  
(ENERGY STORAGE, CAPACITIVE; PULSE GENERATORS; PULSE GENERATORS; PULSE  
GENERATORS)  
(Marx Generators; Marx; Blumlein Lines; Field Reversal)  
LECTURES ON HIGH-VOLTAGE AND PULSE POWER TECHNOLOGY; LECTURE 3: PULSE  
VOLTAGE CIRCUITS

W.L. Willis  
Los Alamos National Labs, Los Alamos, NM 87545  
LASL Report No. LA-UR-80-2082 (10/1980).  
Availability: LA-UR-80-2082

LASL  
The author presents a detailed conceptual discussion of Marx generators, blumleins, and spiral generators with a detailed quantitative discussion of Marx generators included. Several types of Marx generator are discussed, including the Erwin and Martin type generators. Inversion generators, wrapped line generators, and coaxial generators are discussed as sub-topics. Many practical applications are discussed. 8 Refs.

Primary Keywords: Marx Generator; Blumlein; Folded Coax Blumlein; Spiral Generator; Design Considerations; Erwin Marx; Martin Marx  
Secondary Keywords: Inversion Generator; Wrapped Line Generator; Coaxial Generator; Charging Methods

1280  
(POWER CONDITIONING; ENERGY STORAGE, CAPACITIVE)  
(Pulse Forming Networks; Capacitors)  
LECTURES ON HIGH-VOLTAGE AND PULSE POWER TECHNOLOGY; LECTURE 4:  
TRANSMISSION LINES AND CAPACITORS

R.R. Butcher  
Los Alamos National Labs, Los Alamos, NM 87545  
LASL Report No. LA-UR-79-1044 (10/1980).  
Availability: LA-UR-79-1044

LASL  
Lecture 4 begins with a detailed analysis of transmission lines used as pulse forming networks (PFNs) and proceeds to analyze and discuss lumped PFNs. Extensive quantitative analysis is presented with practical considerations included. Type A, B, C, D, E, and F Guillemin networks are discussed with a quantitative analysis of type C networks presented in depth. Capacitors are mentioned briefly with emphasis on parasitic inductance and its effect. An appendix by W.J. Sargeant is included which presents a qualitative and quantitative analysis of energy storage capacitors. Basic capacitor parameters are discussed, leading into a discussion of parasitic inductance, environmental considerations, and lifetime. Construction materials are discussed in some detail. 17 Refs.

Primary Keywords: Transmission Line; Guillemin Network; Mathematical Analysis; Waveform; Capacitor  
Secondary Keywords: Practical Considerations; Corona; Leakage Inductance; Leakage Capacitance

1281  
(SWITCHES, CLOSING; POWER CONDITIONING)  
(Applications; Pulse Forming Networks)  
LECTURES ON HIGH-VOLTAGE AND PULSE POWER TECHNOLOGY; LECTURE 5:  
DISCHARGE CIRCUITS AND LOADS

W.J. Sargeant  
Los Alamos National Labs, Los Alamos, NM 87545  
LASL Report No. LA-UR-80-2771 (10/1980).  
Availability: LA-UR-80-2771

LASL  
This lecture discusses, qualitatively and quantitatively, the design and operation of pulse forming networks. Choice of switches to use is discussed, along with the choice of capacitors and other components. A detailed discussion of practical problems, such as load faults, voltage reversal at the end of the discharge, and varying load impedance, is presented. The main characteristics of spark gaps, ignitrons, thyratrons, and thyristors are described and related to application in PFNs. A brief analysis is presented for pulse transformers with design criteria included. Several types of laser loads are described and characterized. Several specific applications are presented. 11 Refs.

Primary Keywords: Pulse Forming Network; Spark Gap; Thyatron; Ignitron; Thyristor; Pulse Transformer; Design Criteria; Practical and Core Operations  
Secondary Keywords: Voltage Reversal; Time-varying Load; Laser Pumping

1282  
(SWITCHES, CLOSING; SWITCHES, CLOSING)  
(Gas Gaps; Reviews; Gas Gaps, Materials)  
LECTURES ON HIGH-VOLTAGE AND PULSE POWER TECHNOLOGY; LECTURE 6: SPARK  
GAPS

W.L. Willis  
Los Alamos National Labs, Los Alamos, NM 87545  
LASL Report No. LA-UR-80-634 (10/1980).  
Availability: LA-UR-80-634

LASL  
This lecture deals in some detail with breakdown of gases and goes on to relate breakdown mechanisms to spark gap performance. Self-break gaps, electronically triggered gaps, and optically triggered gaps are discussed in some detail, with e-beam triggered gaps mentioned. Formulas abound for determination of spark gap performance as a function of materials and operating parameters. A field enhancement factor is defined and used to calculate the breakdown voltage of several gap configurations, and the breakdown voltage is related to the Paschen curve. The merits of various triggering methods are discussed. Liquid and solid dielectric gaps are discussed qualitatively with some quantitative analysis included. 7 Refs.

Primary Keywords: Spark Gap; Gas Breakdown; Self-break; Triggering; Recovery; Erosion; Paschen Curve  
Secondary Keywords: Liquid Dielectric; Solid Dielectric

1283  
(SWITCHES, CLOSING; SWITCHES, CLOSING)  
(Thyratrons; Ignitrons)  
LECTURES ON HIGH-VOLTAGE AND PULSE POWER TECHNOLOGY; LECTURE 7:  
THYRATRON AND IGNITRON

W.J. Sargeant  
Los Alamos National Labs, Los Alamos, NM 87545  
LASL Report No. LA-UR-80-517 (10/1981).  
Availability: LA-UR-80-517

LASL  
Lecture 7 begins with a conceptual description of thyratrons and ignitrons and proceeds to describe construction and operation of thyratrons and ignitrons in detail. Triggering, charging techniques, and biasing of thyratrons and ignitrons are considered, as are applications and limitations of both devices. Several practical circuits are presented and discussed. The types of thyratrons and ignitrons available are presented and the merits of each are discussed. The state of the art in current thyatron technology is presented, as well as the devices under development for the near future. A compendium of information assembled from manufacturers' data sheets and literature on the theory and application of thyratrons is included as an appendix. 34 Refs.

Primary Keywords: Thyatron; Ignitron; Theory; Application; State-of-the-art; Devices Under Development; Trigger Circuit; Recovery Time  
Secondary Keywords: Charging Circuit; Delay; Recovery Mechanism

1284  
(ENERGY CONVERSION, ELECTRICAL)  
(Power Supplies)  
LECTURES ON HIGH-VOLTAGE AND PULSE POWER TECHNOLOGY; LECTURE 8:  
CHARGING CIRCUITS

W.C. Nunnally  
Los Alamos National Labs, Los Alamos, NM 87545  
LASL Report No. LA-UR-80-2044 (10/1980).  
Availability: LA-UR-80-2044

LASL  
Lecture 8 of the series compliments Lecture 1 by discussing the AC portion of power supplies. Advantages and disadvantages of multi-phase circuits are discussed with design criteria presented. Voltage ramp, monocylic constant current, constant power, and saturable reactor charging systems are presented and analyzed, as well as standard charging power supplies. Criteria are presented on choosing a diode stack and the pitfalls of choosing incorrectly. Several snubber circuits are presented and analyzed in detail. Resonant charging systems are discussed. 11 Refs.

Primary Keywords: Power Supply; Voltage Ramp Power Supply; Monocylic Constant Current Power Supply; Constant Power Power Supply; Saturable Reactor Power Supply; Resonant Charging Power Supply; Choice Of Components; Snubber  
Secondary Keywords: Diode Stack

1285  
(POWER CONDITIONING)  
(Pulse Transformers)  
LECTURES ON HIGH-VOLTAGE AND PULSE POWER TECHNOLOGY; LECTURE 9: PULSE  
TRANSFORMERS AND DIELECTRICS

G.J. Rohwein  
Sandia Labs, Albuquerque, NM 87115  
Sandia Report No. SAND80-0451 (10/1980).  
Availability: SAND80-0451

SANDIA  
Lecture 9 is a comprehensive review and tutorial on air core pulse transformer design. Helical wound and spiral strip transformers are discussed with design criteria presented. Insulation requirements and voltage grading techniques are analyzed with electrostatic shielding included. The effect of shielding on transformer efficiency and methods of minimizing these effects are analyzed. Dielectric properties and several breakdown models for n-Hexane, Mylar, and various oils are presented and discussed. Results of partial discharges are demonstrated. Voltage stress profiles in two dielectric insulator configurations are discussed briefly. 32 Refs.

Primary Keywords: Air Core Transformer; Helical Wire Transformer; Spiral Strip Transformer; FRIZZ; Helical Transformer; Equivalent Circuit; Eddy Current; Electrostatic Shield; Breakdown Model  
Secondary Keywords: Pulse Breakdown; Mylar Film; Breakdown Strength; Conductive Liquid Shield

1286  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Reviews)

LECTURES ON HIGH-VOLTAGE AND PULSE POWER TECHNOLOGY: LECTURE 10:  
MEASUREMENT TECHNIQUES

M.L. Willis  
Los Alamos National Labs, Los Alamos, NM 87545  
LASL Report No. LA-UR-80-2272 (10/1980)  
Availability: LA-UR-80-2272  
LASL

In Lecture 10, various voltage and current diagnostic techniques are discussed. Spark gaps, capacitive dividers, resistive dividers, and combinations of capacitive and resistive dividers are discussed as voltage diagnostics for high voltage circuits. Electrostatic voltmeters are presented for slowly varying and DC circuits. Kerr cells are discussed as an alternative for very fast measurements. Current measurements are discussed in the form of current viewing resistors, Rogowski loops, current transformers, Hall effect probes, and Townsend rotation probes. Several good references are included. 5 Refs.

Primary Keywords: Voltage Measurement; Current Measurement; Spark Gap; Electrostatic Voltmeter; Capacitive Divider; Resistive Divider; Mixed Divider; Current Viewing Resistor; Rogowski Loop; Current Transformer; Hall Effect Probe

Secondary Keywords: Electro-Optic Effect; Townsend Rotation

1287  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Reviews)

LECTURES ON HIGH-VOLTAGE AND PULSE POWER TECHNOLOGY: LECTURE 11:  
PARTICULAR APPLICATIONS

R.P. Butcher  
Los Alamos National Labs, Los Alamos, NM 87545  
LASL Report No. LA-UR-80-3506 (12/1980)  
Availability: LA-UR-80-3506  
LASL

Lecture 11 applies some of the techniques presented in Lecture 10 to derive new, large and current waveforms for a laser load driven by a transmission line pulse forming network (PFN). Lecture 11 then expands upon these measured quantities to derive values for instantaneous power delivered to the load, real power dissipated in the load, total energy delivered to the load, and time varying load impedance. The values are compared to a computer simulation of the circuit and agreement is seen to be good. 2 Refs.

Primary Keywords: Discharge Circuit; Circuit Operation; Voltage Measurement; Current Measurement; Peak Power; Varying Load Impedance

Secondary Keywords: Laser Load

1288  
(REVIEWS AND CONFERENCES: ENERGY STORAGE; POWER TRANSMISSION)  
(Reviews: Systems: Systems)

LECTURES ON HIGH-VOLTAGE AND PULSE POWER TECHNOLOGY: LECTURE 13:  
GROUNDING AND SHIELDING TECHNIQUES

T.P. Burkes  
Texas Tech University, Lubbock, TX 79409  
LASL Report No. LA-UR-80-3330 (10/1980)  
Availability: LA-UR-80-3330  
LASL

Lecture 13 pertains to grounding and shielding techniques for pulse power applications. The author discusses grounding techniques for personnel safety, power flow, and instrumentation. The merits of series grounding, parallel grounding, and single-point grounding are discussed. The advantages of a ground plane are presented, along with some of the pitfalls of utilizing a ground plane improperly. Electrostatic shielding of instrumentation cables is presented with a discussion of stray capacitance coupling included. Magnetic shielding is discussed briefly. 5 Refs.

Primary Keywords: Electrostatic Shield; Magnetic Shield; Grounding Techniques; Safety Ground; Power Ground; Instrumentation Ground

Secondary Keywords: Ground Loop; Humidity Effects; Voltage Gradient; Low Frequency Noise

1289  
(BREAKDOWN STUDIES: INSULATION, MATERIAL)  
(Gas, Electrical: Gas)

INVESTIGATION OF HIGH-VOLTAGE PARTICLE-INITIATED BREAKDOWN IN  
GAS-INSULATED SYSTEMS

R.E. Mootton  
Westinghouse Electric Corp., Pittsburgh PA  
EPRI Report No. EL-1007 (03/1979)  
Availability: EPRI EL-1007  
EPRI

This report describes an experimental and theoretical study of the processes involved in electrical breakdown in compressed gases, where the breakdown is initiated by conducting particles. The report contains a great deal of detailed quantitative data relating to particle-initiated breakdown in large coaxial and uniform electrode systems at voltages of several hundred kV. One finding of interest involves the demonstration that there is a critical particle-to-electrode spacing at the instant of breakdown in SF<sub>6</sub> at gas pressures typically used in practical power transmission equipment. The variation of this critical spacing with SF<sub>6</sub> gas pressure has been determined and the results are reported. The statistical nature of particle-initiated breakdown has also been studied and the effects of the presence of multiple particles and of the duration of application voltage reported. Further results given include data on different gases and gas mixtures, particle sizes and materials, corona and wind effects, particle deformation, AC and impulse voltages and other factors. 12 Refs.

Primary Keywords: Gas-Insulated Systems; Gas Insulation; Particle Track; Particle-Initiated Breakdown; SF<sub>6</sub> Sub 6

Secondary Keywords: Under-Current Transmission

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1290  
(POWER TRANSMISSION)  
(Transmission Lines)

ELECTROSTATIC AND ELECTROMAGNETIC EFFECTS OF ULTRAHIGH-VOLTAGE  
TRANSMISSION LINES

L.D. Zaffanella and D.W. Deno  
General Electric Co., Pittsfield, MA 01291  
EPRI Report No. EPRI EL-802 (06/1978)  
Availability: EPRI EL-802  
EPRI

This report presents the results of research on electric and magnetic field effects of high voltage AC power lines performed at EPRI's Project UHV from January 1974 to December 1977. Only 'electrical' rather than 'biological' research was performed. This research is applicable to UHV as well as to EHV transmission lines. Calculation methods and measuring techniques have been developed for transmission line fields and their effects. Steady state and spark discharge currents induced in persons and objects have been investigated with laboratory and full scale tests using a three-phase UHV line. Different methods to reduce the electric field of UHV lines have been investigated, such as grids of grounded wires and lower voltage circuits built underneath the UHV lines. Unusual effects of high electric fields, such as people's reaction to various types of exposures, wood pole burning, and corona on grounded objects, were experienced during the operation of the UHV three-phase test line. These effects have been investigated and design data have been provided. 9 Refs.

Primary Keywords: Electrostatic; Electromagnetic; Electric Field; Transmission Line; Corona

Secondary Keywords: Induction

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1291  
(INSULATION, MATERIAL)  
(Insulation)

CHARACTERISTICS OF INSULATING OIL FOR ELECTRICAL APPLICATION

T.K. Slott  
Westinghouse Electric Corp., Sharon, PA 16146  
EPRI Report No. EPRI EL-1300 (12/1979)  
Availability: EPRI EL-1300  
EPRI

It has been established that the supply of naphthenic type of petroleum crudes historically used for the manufacture of electrical insulating oils is diminishing, and the oil companies have recommended that the more readily available paraffinic types of crudes should be substituted to produce the insulating oil required by the electrical industry. The purpose of this project was to determine if an insulating oil manufactured from paraffinic-type crudes was interchangeable with the presently accepted insulating oil and would perform the same function without major changes in designs or limit operating conditions. Paraffinic crude oils are known to contain significant amounts of wax that, if not removed, could provide an insulating oil having a high pour point which could interfere with the low-temperature functioning of most electrical equipment. Because of the wax problem, it was necessary to study the behavior of the paraffinic-base insulating oil in representative production-size equipment to ensure low temperature operability. Other studies, such as material compatibility, lubricity of the new oil, arc-formed gas, response to dielectric breakdown levels represented in large power transformers, and accelerated aging in distribution transformers, were important to ensure full acceptance of a replacement oil. This evaluation of experimental oils indicated that paraffinic transformer oils as a class can provide useful supplements or replacements for naphthenic oils. 2 Refs.

Primary Keywords: Oil; Paraffinic; Naphthenic

Secondary Keywords: Transformers; Circuit Breakers

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1292  
(PARTICLE BEAMS, ION; PARTICLE BEAMS, ION; PARTICLE BEAMS, ION)  
(Generation; Transport; Target Interactions)

BEAM REQUIREMENTS FOR LIGHT-ION DRIVEN INERTIAL-CONFINEMENT FUSION

D. Mosher (1); E.G. Colman (1) and S.A. Goldstein (2)  
(1) Naval Research Lab., Washington, DC 20375  
(2) XCOR Inc., Alexandria, VA 22304  
NRL Memorandum Report No. 4397 (11/1980)  
Availability: AD A092472  
NTIS

Pulsed-power and ion-beam production and handling techniques are available for assembling a small-scale ICF experiment. In this report, simple scaling laws for beam focusing, transport, bunching, and packing are combined to define an acceptable range of parameters for ion-beam system modules delivering low-atomic-number (<6) ion beams to a pellet. Techniques for increasing the deliverable beam intensity are then discussed. 18 Refs.

Primary Keywords: Light Ion Beams; Ion Focusing; Ion Transport; Beam Packing; Beam Punching; Pinch Reflex Diode

Secondary Keywords: Inertial-Confinement-Fusion Module; System Requirements

1293  
(POWER CONDITIONING)  
(Pulse Forming Lines)

DESIGN STUDY FOR AN AURORA MODIFICATION LEADING TO A 100-TERAWATT  
NUCLEAR WEAPON RADIATION

A.G. Stewart and G.A. Nuttall  
Henry Diamond Labs, Adelphi, MD 20783  
Report No. HDL-1M 79-3 (02/1976)  
Availability: AD A71339  
NTIS

The AURORA machine can be converted to provide beam power outputs near the 1E14 W power level into low impedance loads. The proposed conversion is based on a novel approach to pulse power intensification. The approach can be adapted to AURORA in differing configurations. A device of toroidal geometry utilizes the fast pulse charge capability of the AURORA generator to inject a traveling electromagnetic wave into a toroidal oil-filled coaxial line. From the point of injection, electromagnetic waves are propagated along the axis of the torus in opposite directions and at some time will meet each other at the end of the torus diametrically opposite the injection point. As the electromagnetic waves overlap, that portion of their energy stored in the magnetic field will be transformed into electrostatic energy, and the voltage in this region will double. At some optimum preselected time  $t_1$ , where  $t_1 > t$ , the toroidal line is then switched circumferentially into an oil-insulated three-electrode parallel plate transmission line to the diode load. A transmission-line model for the complete system has been developed and analyzed by computer to determine energy transfer efficiencies and power inputs into a matched ohmic load. It has been determined that peak power levels of 90 TW are achievable in a pulse of 30 ns full width at half maximum.

Primary Keywords: High Pulsed Power; High-Intensity Electron Beams; Accelerator Technology

1294  
(PARTICLE BEAMS, ION)  
(Generation)  
HIGH IMPEDANCE ION DIODE EXPERIMENT ON AURORA  
R.A. Mager, F.C. Young, A.T. Droop, G. Cooperstein, S.A. Goldstein, D. Graybill, S.E. Mosher, G.A. Huttlin, K.G. Morris and A.G. Stewart  
Naval Research Lab., Washington, DC 20375  
NRL Memorandum Report No. 4477 (03/19A11)  
Availability: AD A096561  
NTIS

The ion diode experiments on Aurora described in this paper have produced up to SE 16 protons with energies of 5 MeV and pulse durations of 150 ns. The corresponding average proton current exceeds 50 A on 2% of the total current. These numbers give 40-keV energy in the proton beam. The ion generation efficiency compares favorably with computer simulations. In addition to protons, a carbon ion component of greater than SE 14 ions was extracted from Aurora. The energy of these ions was not determined, but their number may be larger depending on their charge state and hence their energy. 1 Ref.  
Primary Keywords: Light Ion Beam; High Impedance Ion Diode; Simulation  
Secondary Keywords: Aurora Facility

1295  
(SWITCHES, CLOSING)  
(Surface Discharge)  
ELECTRICAL  
HIGH-PRESSURE SURFACE-DISCHARGE PLASMA SWITCHES  
W.J. Sargeant

Los Alamos National Labs., Los Alamos, NM 87545  
IEEE Trans. PAS-50, Vol. PS-8, No. 3, pp. 216-226 (09/1980).  
Surface discharge plasma switches operating at high gas pressures with gas discharge laser and resistive loads have been the subject of experimental investigations in recent years. The particular interest has been in the low-conductance uniform multichanneling evident in these switches in conjunction with the high hold-off voltages that have now been achieved at multiatmosphere operating gas pressures. This paper reviews the progress to date and presents a theoretical model of the surface discharge plasma switch that explains the observed data. 10 Refs.  
Primary Keywords: Surface Discharge; Mylar Substrate; Multi-Channel;  
Secondary Keywords: Very Small Jitter; Variation Of Pressure  
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1296  
(SWITCHES, CLOSING)  
(Thyratrons)  
INSTANT START THYRATRON SWITCH  
S. Marx and D. Turnquist

EG&G Inc., Salem, MA 01970  
ERADCOM Report No. DELET-TR-79-0270-1 (01/1981)  
Availability: AD A096579  
NTIS  
Efforts into the development of a megawatt instant-on hydrogen thyratron are underway. The design work has been divided into three major areas: (1) cathode development, (2) envelope design, and (3) reservoir development. Two experimental thyratrons have been fabricated in order to study the cold emission characteristics of a tungsten matrix cathode material. Design work has been completed on a new lightweight envelope assembly. Finally, efforts into the development of a reservoir system are described. 1 Ref.  
Primary Keywords: Thyratron; Hydrogen Thyratron; Cold Cathode  
Secondary Keywords: Gas Filled Device; Switch Tube

1297  
(ENERGY STORAGE, MECHANICAL; PULSE GENERATORS; SWITCHES, OPENING)  
(Rotating Machines, Systems; Explosive Fuses)  
CURRENT INTERRUPTION IN INDUCTIVE STORAGE SYSTEMS WITH INERTIAL CURRENT SOURCE

J.M. Vitkevich, D. Conte, R.D. Ford and W.H. Lupton  
Naval Research Lab., Washington, DC 20375  
NRL Memorandum Report No. 4153 (03/1980).  
Availability: AD A083514  
NTIS  
Utilization of inertial current source inductive storage with high power output requires a switch with short opening time. This switch must operate as a circuit breaker, i.e., be capable of carrying the current for a time period characteristic of inertial systems, such as homopolar generators. For reasonable efficiency, its opening time must be fast to minimize the energy dissipated in downstream fuse stages required for any additional pulse compression. A switch that satisfies these criteria, as well as other requirements such as that for high voltage operation associated with high power output, is an explosively driven switch consisting of large number of gaps arranged in series. The performance of this switch in limiting and/or interrupting currents produced by large generators has been studied. Single switch modules were designed and tested for limiting the commutating current output of 1 MW, 60 Hz generator and 500 KJ capacitor banks. Current limiting and commutation were evaluated, using these sources, for currents ranging up to 0.4 MA. The explosive opening of the switch was found to provide an effective first stage for further pulse compression. It opens in tens of microseconds, commutates current at high efficiency (>90%) and recovers very rapidly over a wide range of operating conditions. 29 Refs.  
Primary Keywords: Inductive Energy Storage; High Current Pulses;  
Secondary Keywords: Opening Switches; Terawatt Pulse Generators

1298  
(PARTICLE BEAMS, ELECTRON)  
(Transport)  
EXPERIMENTS ON THE INJECTION OF RELATIVISTIC ELECTRON BEAMS INTO PREFORMED CHANNELS IN THE ATMOSPHERE  
M. Raleigh (1), J.D. Sethian (1), R.B. Fiorito (2), L. Allen (1), R.F. Fernald (3) and J.R. Greig (1)  
(1) Naval Research Lab., Washington, DC 20375  
(2) Naval Surface Weapons Center, Silver Spring, MD 20910  
(3) JATCEP Inc., Alexandria, VA 22304  
NRL Memorandum Report No. 4220 (05/1980).  
Availability: AD A086732  
NTIS

Reduced-density channels were created by designating a path through the atmosphere by laser-induced, aerosol-initiated air breakdown and heating the air along the path with a guided electric discharge. A Nd: glass laser (60J, 40 nsec), focused with a 5 m f.l. lens, was used and air breakdown was enhanced by the presence of a light smoke. The electric discharge (200 kV, 10 A peak current, 200 microsec) followed the laser path and damped in 6 microsec. 30 microsec later a hot, reduced density, partially ionized channel had formed. The diameter of the channel was 2.0 cm and channels of length up to 2 m have been produced. Using a field emission diode with a 43 um titanium foil anode, and intense relativistic electron beam (27 nsec, 2.6 MeV, 1.2 MeV) was produced which could be seen propagating in the unperturbed atmosphere for distances of 100 m. The beam was injected into the preformed channel within 3 cm from the anode to study the beam-channel interaction. Conditions in the channel were varied by controlling the time between creation of the channel and injection of the BES. When injected into a conductive channel with density 6.55 g/cm<sup>3</sup> and radius 0.125 cm, the beam expanded and was ejected from the channel within 10 cm of travel. But when injected into a channel with much lower conductivity and density 3E14 g/cm<sup>3</sup> the beam propagated in the channel and the effect of the reduced scattering was observed. 19 Refs.  
Primary Keywords: Relativistic Electron Beam; Channel; Atmosphere

1299  
(BREAKDOWN STUDIES)  
(Electrical)  
MODELING AND MEASUREMENT OF THE INITIAL ANODE HEAT FLUXES IN PULSED HIGH-CURRENT ARCS  
D. Johnson and E. Pfender

University of Minnesota, Minneapolis, MN  
IEEE Trans. PAS-50, Vol. PS-7, No. 1, pp. 44-48 (03/1979).  
An anode heat flux model has been developed for pulsed high-current DC arcs. The model is based on temperature time-history measurements of the rear face of a very thin plane anode and high-speed streak photographs of the arc. The arc heat flux model is derived from a comparison of experimental data with an analytical solution of the one-dimensional heat conduction equation and the arc intensity and timing information obtained from high-speed photographs. A simplified input heat flux model consisting of connected segments of linearly varying heat flux with respect to time is used. Duration of the individual segments is determined from the streak photographs and the analytical notch of measured rear-face temperature history and the numerical solution. Results using argon gas at atmospheric pressure indicate an initial transient heat flux regime of 100 microsecond duration with a peak heat flux of 2E9 W/m<sup>2</sup>, followed by a quasi-steady heat flux regime with a heat flux of 1E9 W/m<sup>2</sup>. 8 Refs.  
Primary Keywords: Anode Heat Flux Model; Thin Plane Anode; Transient Study; Anode Temperature Measurement  
Secondary Keywords: Finite Difference Calculation  
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1300  
(BREAKDOWN STUDIES)  
(Gas, Radiation)  
X-RAY PREIONIZED HIGH-PRESSURE KRF LASER  
S. Sumida, M. Ohara and T. Futsuka

Kansai University, Kishikuji, Yokohama-shi, Japan  
APPL. PHYS. LETT., Vol. 33, No. 11, pp. 913-915 (12/1978).  
The authors consider flash x-ray sources as a form of gas laser preionization. The output energy of the laser is seen to increase substantially over that produced by conventional ionization wires, over a much wider pressure range. Spatial uniformity of the output beam is also seen to be greatly improved. 5 Refs.  
Primary Keywords: X-ray Preionization; Glow Discharge; High Pressure; Large Volume Ionization  
Secondary Keywords: Krf Laser; Uniform Beam  
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1301  
(INSULATION, MATERIAL; INSULATION, MATERIAL)  
(Liquid, Solid)  
A PROGRAM TO EVALUATE, DEVELOP AND TEST POROPLASTIC MATERIALS AS IMPROVED ELECTRICAL INSULATION FOR HIGH POWER UNDERGROUND CABLES  
L.W. Nicholas, L. Gilson and A.G. Obermayer

Molecular Research Corp., Cambridge, MA 02142  
EPRI Report No. EPRI-EL-312 (04/1977).  
Availability: EPRI-EL-312  
EPRI  
This report presents the results of a project to develop Poroplastic Film, an ultramicrocrystalline material invented by Molecular Research Corp., as a low loss substitute for the cellulose paper tapes presently used in the manufacture of high pressure oil-filled cable. Structurally, Poroplastic is a stable film consisting of a cellulose triacetate matrix which incorporated a large column of liquid. Pore diameters in the matrix measure several tens of Angstroms and the relative liquid can be controlled to range from as little as 5% to as much as 25%. For use as a cable dielectric, the liquid incorporated in the Poroplastic was a dielectric oil. By virtue of the high oil loading, the material exhibited dielectric properties superior to those of cellulose paper; typically a power factor of 0.02%, a relative dielectric constant of 2.2 and a 60 Hz breakdown stress of 80 kv/mm (2 kv/mil). Mechanically, however, the basic material was inferior to cellulose paper in terms of its tensile strength, stiffness, frictional and fluid transport characteristics. The high cost of the material which was evolving, coupled with the difficult technical problems yet to be overcome, did not warrant further continuation of this work at this time. 9 Refs.  
Primary Keywords: High Pressure Oil-Filled Cable; Synthetic Tapes; Poroplastic  
Secondary Keywords: Underground Transmission; Cable Insulation  
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1302  
(ENERGY STORAGE, MECHANICAL)  
(Rotating Machines)

SUPERCONDUCTING ROTOR RESEARCH

B. B. Gamble, T. A. Kaim and P. A. Pios  
General Electric Co., Schenectady, NY 12301  
EPRI Report No. EPRI EL-1264 (11/1979).  
Availability: AD A255612  
NTIS

This report summarizes work completed for the Air Force Aero propulsion Laboratory in Phase I of a program entitled Superconducting Rotor Research. The objective of this program is to incorporate new materials in the design of an airborne, 25 MW, high-speed, superconducting generator. The rotor of the generator will be constructed and its current density demonstrated. The Phase I work consisted of a sizing study to select the machine configuration and dimensions, a survey of superconducting materials, and selection of the superconductor for this application. 13 Refs.

Primary Keywords: Cryogenic; Superconductivity; Synchronous generators

1303  
(SWITCHES, CLOSING)  
(Thyristors)

LIGHT-TRIGGERED THYRISTORS FOR ELECTRIC POWER SYSTEMS

V. A. K. Temple and A. R. Ferro  
General Electric Co., Schenectady, NY 12301  
EPRI Report No. EPRI EL-1349 (03/1980)  
Availability: EPRI EL-1349  
EPR

A program to develop a method of triggering a 5000, 2400-volt, 1000 amp thyristor with a light source is described. Normally, these devices are electrically triggered by the need for placing a large amount of the time in the design of the thyristor package. The electrical triggering method is described. The thyristor package, expensive and complex, in this program, a light-sensitive gating method was developed. With appropriate and flying layers built into the package, the thyristor LEDs and LEDs were used as the light source. Fiber optic cables were used to deliver the light. The light source was connected to the thyristor package. Results were a 5000-volt thyristor to handle a voltage rate-of-change of 2000 volts per microsecond with a light input to the thyristor gate of 10 microamps. A problem was anticipated and investigated in high rates of current flow and the effect of light triggering. This resulted in excess temperature levels in local and spots where the current flow was initiated. Packaging and light source options are discussed. 13 Refs.

Primary Keywords: Thyristors; Power Electronics; Optical Triggering System

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1304  
(SWITCHES, CLOSING)  
(Thyristors)

LIGHT-TRIGGERED THYRISTORS FOR ELECTRIC POWER SYSTEMS (PHASE 2)

V. A. K. Temple and B. Jackson  
General Electric Co., Schenectady, NY 12301  
EPRI Report No. EPRI EL-1349 (03/1980)  
Availability: EPRI EL-1349  
EPR

This report marks a milestone in the development of thyristors suitable for HVDC applications. Three devices were constructed with 5, 4, and 2 amplifying stages, respectively, with several sub-variations. Of these the 4 amplifying stage GEs type D device and all variations (A, B, C) of the two stage GEs design proved sufficiently reliable for a one for one replacement of the normal, electrically triggered 2.6 kV HVDC cell. Important device characteristics other than a typical 160 V/m crossover or better dv/dt at 105 deg C and 1800 volts include the following: (1) typical forward breakdown voltage of 2400 volts; (2) typical reverse breakdown voltage of 3100 volts; (3) dv/dt capability of 200 V/microsecond to 2200 volts; (4) forward drop at 105 deg C, 1000 amperes of 1.3 volts and, finally, (5) a typical photo threshold of 10 to 20 nanowatts of incident photo energy. Surge sensitivity and other device ratings are similar to the conventional electrically fired device. It is also significant that both the fabrication and packaging of these devices took place in a production facility and that the light triggered thyristor could be fabricated with the same process. Apart from the extra sensitivity of the regular electrically triggered device. 13 Refs.

Primary Keywords: Thyristors; Power Electronics; Optical Triggering System

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1305  
(BREAKDOWN STUDIES)  
(Review)

THE PREVENTION OF ELECTRICAL BREAKDOWN IN SPACECRAFT

R. M. Paul and J. Burrows  
General Electric Co., Schenectady, NY 12301  
EPRI Report No. EPRI EL-1349 (03/1980)  
Availability: AD A255612  
NTIS

This paper on high voltage electrical breakdown provides a basic understanding of the phenomena and problems encountered in the use, design, and fabrication of high power systems for spacecraft. The material was compiled from the literature listed in the bibliography and from conferences with experienced personnel at Goddard Space Flight Center, JPL, and other laboratories. Pasadena, California, and the University of Chicago. 13 Refs.

Primary Keywords: Electrical Breakdown; Design Considerations

1306  
(BREAKDOWN STUDIES; INSULATION, MATERIAL)  
(Gas; Electrical; Gas)

PARTICLE-INITIATED BREAKDOWN IN GAS DIELECTRIC CABLE INSULATION EXPANDED SCOPE PROGRAM

C. M. Cooke  
Massachusetts Institute of Technology, Cambridge, MA  
EPRI Report No. EPRI EL-1264 (11/1979).  
Availability: EPRI EL-1264  
EPR

The adverse influence of conducting particle contaminants in gas-insulated power apparatus was investigated in a series of experiments that employed coaxial configurations and DC voltages to 1500 kV. Particle dynamics was shown to be important and related to breakdown initiation in the gas. Both SF<sub>6</sub>/sub 6/ and N<sub>2</sub>/sub 2/ gases at pressures from 1 to 16.6 atm. abs. were used. The particles were intentionally introduced and ranged from 1.5 to 6.4 mm. spheres and wires. Effects in the gas gap as well as along surfaces of solid insulators were studied. Visual observations, photographs and electrical measurements helped in distinguishing various processes. Particles could reduce the insulation performance by factors of 3 to 5 and were especially significant when moved to the center conductor. By coordination of this work with a separate study at the Westinghouse R&D laboratory, a comparison between DC and AC performance was made. Generally the DC breakdown values exhibited higher values, though their limit was similar to that found under AC. Overall fundamental forces and processes which involve particle contamination effects were identified and found to be the same for DC and AC voltage stresses. 30 Refs.

Primary Keywords: Gas Insulation; Particle-initiated breakdown; SF<sub>6</sub>/sub 6/ Dielectrics

Secondary Keywords: Gas-Insulated Cable; Underground Transmission Cables; 1520 ELECTRIC POWER RESEARCH INSTITUTE, INC., REPRINTED WITH PERMISSION

1307  
(INSULATION, MATERIAL; INSULATION, MATERIAL)  
(Gas; Liquid)

SF<sub>6</sub>/sub 6/ OIL DIELECTRIC FOR POWER TRANSFORMERS

E. J. Walsh, J. A. Robinson and R. C. Wendel  
Westinghouse Electric Corp., Sharon, PA 16146  
EPRI Report No. EPRI EL-1358 (03/1980)  
Availability: EPRI EL-1358  
EPR

This project was designed to evaluate the potential for providing a superior gas-oil insulating and cooling system for liquid filled transformers. The potential benefits of using the electronegative gases, sulfur hexafluoride, SF<sub>6</sub>/sub 6/, or hexafluoroethane, C<sub>2</sub>/sub 2/ or nitrogen gas normally used in gas-oil filled transformers were examined. A test program involving electrical, chemical, and physical properties indicated that the SF<sub>6</sub>/sub 6/-oil combination appeared satisfactory as an insulating medium. No short term reduction in insulating or cooling capacity was determined in SF<sub>6</sub>/sub 6/-oil filled transformers. However, some of the results obtained in the longer term transformer testing using SF<sub>6</sub>/sub 6/ gas and oil indicated that prolonged exposure of currently designed transformers to SF<sub>6</sub>/sub 6/ is to be avoided. It was determined that due to the high degree of solubility of SF<sub>6</sub>/sub 6/ in transformer oil, degassing under thermal or electrical stress could result in extensive bubble formation. It was determined, however, that under our test conditions, SF<sub>6</sub>/sub 6/ gas bubbles did not reduce the insulating capacity of the liquid medium as did nitrogen gas bubbles under the same test conditions. As a result of this study, many previously unknown areas concerning electronegative gas-oil systems have been clarified but the results from these studies have given rise to some new concerns for allowing SF<sub>6</sub>/sub 6/ to enter existing oil filled transformers. 13 Refs.

Primary Keywords: Sulfur Hexafluoride; Transformers; Oils; Dielectric Strength; Hexafluoroethane

Secondary Keywords: Solubility

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1308  
(BREAKDOWN STUDIES)  
(Gas; Electrical)

STUDY OF LIGHTNING CURRENT MAGNITUDE THROUGH DISTRIBUTION ARRESTERS

C. L. Gaithe, M. S. Moshikian and K. Johnson  
The Detroit Edison Co., Detroit, MI 48226  
EPRI Report No. EPRI EL-1140 (09/1979).  
Availability: EPRI EL-1140  
EPR

This project was undertaken by the Detroit Edison Company on behalf of the Electric Power Research Institute to: 1. Determine the current magnitude of lightning surges discharged through distribution arresters. 2. Determine the frequency of lightning strokes through distribution arresters. In the fulfillment of these objectives, the currents were determined from arrester gap etchings caused by lightning surges. Inspection of the gaps led to the conclusion that two distinct types of etchings had been produced. These were compared to 400 microsecond surges and to surges of longer duration produced by tests at the General Electric Laboratory. 5 Refs.

Primary Keywords: Surge Arresters; Lightning Currents; Distribution Surge Protection; Lightning Currents; Distribution Arresters; Lightning Currents

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Primary Keywords: Application; Coupling; EMP; Interaction  
Secondary Keywords: Aerospace System; Aircraft; Ground Based Systems

PHOTOGRAPHIC OBSERVATIONS OF IMPULSE BREAKDOWN IN SHORT VACUUM GAPS  
I. D. Oshinaga and B. D. Franklin  
University of Strathclyde, Glasgow, Scotland  
Journal of Physics B: Applied Physics, Vol. 12, No. 8, pp 1285-1292  
(1979)

Primary Keywords: Optical Emission; vacuum Gen. Several Electrode Materials; Cathode Vapor; Anode Vapor; Anode Vapor Gap Closure; Modeling

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N.L. Hazen, M.C. Huber and E.M. Reeves  
Harvard University, Cambridge, MA  
No. NASA-CR-109085, 376 (03/1969).  
Availability: NT0-20748  
NTIS

NTIS  
An apparatus for pulsing a high speed transmitter having pulser delay times in the nanosecond range. The combination of solid state and spark gap devices provides protection against high voltages for both transient and steady low-throughput conditions. (Author)  
Primary Keywords: Electrical Faults; Oscill; Sine Wave Transmitters; Circuit Protection; Electronic Modules; High Voltage

HIGH VOLTAGE BREAKDOWN STUDY

Authors Unknown  
Ion Physics Corp., Burlington, MA 01803  
ECOM Report No. ECOM-00394 (06/1972).  
Availability: AD 711556

NTIS

This is the final report on a series of carefully controlled experiments designed to obtain data on vacuum breakdown of a high-voltage vacuum tube envelope. A description of the apparatus used and precautions taken to provide adequate controls are included, as are results from many of the preliminary experiments. The controls are considered in detail and are shown to be adequate for the experiments discussed. The breakdown with and without magnetic field in various configurations is presented. Since the literature was fragmented and contradictory, frictional design (the effects of parameter changes are studied) was used to obtain a more complete picture of the problem, along with the parameter range of each, are identified and discussed. The statistical methods applied to the data are also presented and the resultant accuracy is discussed. Finally, each individual experiment is presented along with the significant results obtained. 48 Peps

Primary Keywords: Insulation Strength; Breakdown With Magnetic Field;  
Yates Algorithm; Statistical Analysis

(Electrodes)

C.S. Fox, M.P. Robb, Thomas and J. A. Schmitt  
US Army Electronics Command, Fort Belvoir, VA  
USAECE Report On Task 17462709D45-06 (28/12/99)  
Availability: AD 596478

In-house studies were made on the failure mechanisms of the positive electrodes (anodes) in lamps with 25, 40, 60, 75, and 100-w power ratings. New materials, geometrical designs, and electrode-coating techniques were developed. The positive electrodes of lamps with 25- and 40-w ratings operating under normal conditions showed no signs of failure. The positive electrodes of lamps with 60- and 75-w ratings failed because of thermal or mechanical failure. The report concludes that a few promising anode designs are worthy of further development. Also, 25- and 30-kilohm lamps with various positive electrodes were built from six manufacturers for evaluation.

Principal words: Electroluminescence; Lamp; Lamp design; Lamp design; Second ray; Fluorescence; Cathodoluminescence

(ELECTROLYTIC CORROSION, COATING)  
 (ELECTROLYTIC CORROSION, MATERIALS)  
 (ELECTROLYTIC CORROSION, MATERIALS)  
 R. Dethlefsen  
 General Motors Corp., San Diego, CA 92112  
 ADL REPORT NO. AD-717 064(1968)  
 AVAILABILITY: AD-670185

Experiments on electrode erosion due to magnetically driven high current arcs are described together with a review of the literature. The range of parameters is arc current 2 to 3 kA, pressure in vacuum 0.01 to 0.1 mm Hg, magnetic field 0.05 to 0.1 T. The arc travels in a uniform magnetic field between segmented rail electrodes. The self-magnetic field of the current feed rails is reduced to a negligible level. Measurements of the arc velocity are given for all plates at various angles of attack between the electrode rails. They are traversed by the moving arc so that the plates are exposed to the anode attachment on one side and to the cathode detachment on the other side. Initial parametric studies have shown that the erosion rate increases with increasing gas pressure. Anion and cation currents are measured at different angles with no arc glow during the arc at intermediate positions. Tungsten, rhenium and niobium samples showed the highest erosion resistance of these metals tested with a nitrogen arc. Oxide layers on copper can disperse erosion. The cathode, while they increase the tendency for erosion, do not change the erosion rate. The results are discussed and applied for increased erosion resistance. Thermal and electrical properties of various electrode materials have been compiled. High-speed pictures have indicated that the moving arc attaches on one or several points, it jumps, it spreads, splits an anode and cathode, etc. **Primary keywords:** Arcs; Arcs; Magnetic Field; Arc Velocity; Measurements; Erosion; Track; Triggering

DEVELOPMENT OF A CURRENT LIMITER USING VACUUM ARC CURRENT COMMUTATION  
C.W. Kimbrell, J.G. Gorman, F.A. Holmes, P.R. Entage, J.V.R. Heberlein  
and R.E. Voshell  
Westinghouse Electric Corp., Pittsburgh PA  
EPRI Report No. EPRI EL-1221 (10/1979).  
Availability: EPRI EL-1221

Phase 1 showed the feasibility of developing a current limiter using vacuum arc current commutation. In concept, the electrodes of a vacuum device would be separated during the built current rise, and the subsequent formation of a magnetic field would cause the arc current to commutate into a parallel capacitor and ultimately into a parallel current limiting resistor. The feasibility of commutating at arc current levels to 8.5 kA was demonstrated. However, the parallel capacitance was prohibitively large at 300 microfarad. The objective of Phase 2 has been to increase the commutating current of the single 120 degree device while also reducing the value of the parallel capacitance. A total of 14 prototype vacuum devices were designed, built and evaluated, and the major parameters varied were device geometry, characteristics of the parallel circuit, electrode arctuation speed, shape of the applied transverse magnetic field, and on wave electrode separation, and the use of a series connecting vacuum interrupters. Progress can be determined by comparing the commutation levels with Phase 1. For the earlier 15KV circuit, the commutation level increased to 14.5kA for a parallel capacitance of 50 microfarad. In particular, commutation levels of 12kA to 15kA were observed in circuits where the transient recovery of the vacuum device at the time terminated with a 25kV current. A Phase 3 program is recommended aimed at further improving the device performance. 15 Refs.

the device performance is 15 KeV.  
Primary Keywords: Fault Current Limiter; Current Limiting Device; Arc  
Instability; Vacuum Switch  
Secondary Keywords: Vacuum Interrupter; Circuit Breaker  
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METHOD OF UTILIZING SPARK-CAP FOIL SWITCHES IN DETERMINING DETONATION VELOCITIES OF SOLID EXPLOSIVE MATERIALS

G.W. Carter  
Lawrence Livermore Lab, Livermore, CA 94550  
(03-13-9)  
Av. 1st St. 1st Fl. 94550-6097

Primary Keywords: Intonation; Velocity; Instrumentation; Electric  
Switches  
Secondary Keywords: Spark Gap Foil Switches

6. SYMPOSIUM: TECHNICAL CONFERENCE ON HOMOLOGICAL GENERATORS

B. A. Alivovskiy  
 Sci. Report No. 7-80-NT-703-250-70 (OS-1970)  
 Trans. from: Izvestiya Vysshikh Uchebnyykh Zavedeniy 7, 802-804 (1969)  
 Availibility: RAU Penza  
 AD 710254  
 NTIS

At a conference on homopolymer generators, 35 reports were heard and discussed. Some of the topics covered were: The questions of generator design and design of the electrolyte; The best homopolymer generator designs of different types; The problem of solid-state generators; The merits of these generators and their practical prospects in electrochemical and electronic industries.

COAST GUARD (LURIC)

SPARK G.  
Levy  
100M, Fort Monmouth, NJ 07703  
JREF, PO, Report No. 2434 (04/1964)  
AUGUST 1 1964 AD 501085

[illegible]

1325  
(PULSE GENERATORS)  
( Marx )  
HIGH-VOLTAGE PULSE VOLTAGE GENERATOR  
I. I. Kalyetskii, V. I. Kurats and V. I. Safronov  
FTD Wright-Patterson AFB, OH  
No. FTD-ID(RS)T-1972-79, 7p (12/1979).  
Availability: AD-A087 884/3  
NTIS  
No abstract available.  
Primary Keywords: Pulse Generators; Spark Gaps; High Voltage;  
Translations; USSR  
Secondary Keywords: Arkadyev Marx Generators; Marx Generators;  
NTISDODX; NTISFNUR

1327  
(POWER CONDITIONING)  
(Pulse Transformers)  
AN IMPROVED PULSE TRANSFORMER FOR HIGH-VOLTAGE APPLICATIONS  
T. F. Turner  
Stanford University, Stanford, CA 94305  
Technical Report M.L. No. 609 (05/1959).  
Availability: AD 219114  
NTIS  
A method of designing high-voltage pulse transformers using less  
core material than conventional methods is presented. This method  
creates a constant gradient along the windings. Leakage inductance is  
reduced, but distributed capacitance is increased. 2 Refs.  
Primary Keywords: Pulse Transformers; Conventional Design; Constant  
Gradient Design; High Efficiency; Core Material  
Savings

1329  
(DIAGNOSTICS AND INSTRUMENTATION; BREAKDOWN STUDIES)  
(Voltage; Surface Flashover)  
ELECTRO-OPTICAL MEASUREMENTS OF SOLID INSULATOR SURFACE FIELDS AND  
SURFACE CHARGING IN VACUUM  
D. M. Myslop, J. E. Thompson and T. S. Sudarshan  
University of South Carolina, Columbia, SC  
SCR Report No. GRC 85-233 (04/1985).  
Availability: GPO 85-203  
NTIS  
Electro-optical measurements of the electric field along insulator  
surfaces and in the bulk of insulator materials have been made to  
determine the mechanisms associated with insulator surface flashover.  
The Pockels effect in KDP has been used in conjunction with a  
polarization interferometer and a pulsed laser to measure interfacial  
and bulk fields for KDP/vacuum interfaces. The results show that the  
solid insulator surface and bulk electric field distributions are  
spatially non-uniform. The electric field at the cathode is  
considerably anisotropic. The field at the anode is reduced. The  
time evolution and steady state behavior of the insulator electric  
field distributions for DC, 60 Hz AC, and pulsed excitations will be  
presented. 17 Refs.  
Primary Keywords: Surface Flashover; Bulk Insulator; KDP Crystal;  
Vacuum Interface; Non-run Electric Field

1331  
(PULSE GENERATORS; ENERGY STORAGE; CHEMICAL)  
(Flux Compression; Flux Compression Generators)  
DESIGN OF EFFICIENT EXPLOSIVELY DRIVEN ELECTROMECHANICAL ENERGY  
CONVERTERS  
S. Frankenthal, O. P. Menley and Y. M. Treve  
American Science and Engineering, Inc., Cambridge, MA  
Journal of Applied Physics, Vol. 36, No. 7, pp 2137-2139 (07/1965).  
The conversion efficiency of a lumped-parameter, explosively  
driven electromechanical energy converter is studied. Numerical  
results of the study, which show the relationship among the device  
parameters required for unit conversion efficiency, are presented. 5  
Refs.  
Primary Keywords: Flux Compression Generator; Conversion Efficiency;  
Parameter Study; Design Suggestions  
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1335  
(ENERGY STORAGE; MECHANICAL)  
(Rotating Machines)  
INVESTIGATION OF OPERATING MODES OF HOMOPOLAR SHOCK GENERATOR WITH  
REGULATION OF EXCITATION FLOW  
V. V. Kharitonov  
FTD Report No. FTD-ID(RS)T-0662-80 (05/1980).  
Trans. From: Elektrotehnika (USSR) 12, 43-46 (December 1971) By  
Robert Potts  
Availability: AD A084849  
NTIS  
The calculation of transient processes in the excitation of a  
homopolar generator is examined. Several operating modes of the  
generator are analyzed, with emphasis on the regulation of the  
excitation. 5 Refs.  
Primary Keywords: Homopolar Generator; Analysis; Excitation

1337  
(PULSE GENERATORS; ENERGY STORAGE; CAPACITIVE)  
(Trigger; Capacitors)  
GENERATION OF VOLTAGE PULSES FOR TRANSVERSE DISCHARGES  
V. N. Ischenko, V. N. Lisitsyn and V. M. Starinskii  
Institute of Semiconductor Physics, Academy of Sciences of the USSR,  
Novosibirsk, USSR  
Instruments And Experimental Techniques, Vol. 20, No. 3, pp 725-727  
(04/1977).  
Trans. From: Priroda i Tekhnika Eksperimenta 3, 133-105 (May-June 1977).  
This paper presents the results of an effort to increase above 10  
J the pulse energy of a voltage-pulse generator described earlier.  
Another voltage-pulse generator is also described which was assembled  
using second and 15-17 condenser to yield 300-J pulses. The  
voltage-pulse generator is so designed as to provide a rate of rise  
of current into an ohmic load of 1.3E12 A/sec. 4 Refs.  
Primary Keywords: Pulse Generators; Capacitors; Rate of Rise; Increase  
Capacitor Improvement; Condensers  
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1338  
(BREAKDOWN STUDIES)  
(Vacuum; Particle)  
MICROPARTICLES IN HIGH-VOLTAGE ACCELERATOR TUBES  
G. F. Griffith (1) and D. A. Eastham (2)  
(1) Wisking College, New Concord, OH 43762  
(2) Research Lab, Daresbury, Warrington WA44AD, UK  
Journal of Physics D: Applied Physics, Vol. 12, No. 9, pp L105-L107  
(09/1979).  
Microparticles with radii greater than 2 microns have been  
observed in a high-voltage vacuum accelerator tube. The charge  
acquired by most of the particles is similar to the contact charging  
of a conducting sphere on a plane. 5 Refs.  
Primary Keywords: Vacuum Breakdown; Microparticle; Charge Measurement;  
Velocity Measurement  
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1340  
(PARTICLE BEAMS; ELECTRON)  
(Generation)  
A PULSED ACCELERATOR BASED ON THE 'ELIT-1' ACCELERATOR  
L. P. Fominskii  
Novomoskovsk Branch, GIAP  
Instruments And Experimental Techniques, Vol. 18, No. 6, pp 1674-1675  
(12/1975).  
Trans. From: Priroda i Tekhnika Eksperimenta 6, 19-21  
(November-December 1975).  
A pulsed electron accelerator with an explosive-emission cathode  
is described which has been created on the basis of the 'ELIT-1'  
accelerator and differs from the latter in the use of transformer oil  
as the dielectric medium (this permits the charging voltage and  
storage capacitance to be increased). The beam current reaches 20 kA  
and energy of up to 1.5 MeV and a pulse length of approximately 25  
nsec. 8 Refs.  
Primary Keywords: E-beam Generation; Explosive Emission Cathode;  
ELIT-1 Accelerator; Oil Insulation; 1.5 MeV Beam  
Energy; 20 kA Beam Current; 25 ns Pulse Duration  
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1342  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Data Transmission)  
FIBER-OPTIC HIGH VOLTAGE ISOLATION OF CAMAC HIGHWAY  
S. T. Lee and C. D. Moore  
General Atomic Co., San Diego, CA 92121  
No. GAT-7102-78, 7p (11/1979).  
Availability: GA-A-15659  
NTIS  
Fault analyses of the Doublet III Machine predict that a  
worst-case 30 kV might accidentally appear on control and data  
acquisition wiring connected to CAMAC interface systems. Such an  
accident could cause damage in CAMAC and computer equipment as  
distant as the control room, with attendant possibility of personal  
injury to operators and experimenters. Protection for control room  
personnel and equipment has been provided in the form of fiber-optic  
data link systems installed in CAMAC parallel branch and byte serial  
highways. Both fiber-optic data link systems were designed,  
documented, and fabricated at General Atomic, using vendor-supplied  
fiber-optic transmitter and receiver modules. (ERA citation 05-011007.  
System; Data Acquisition Systems; Electric Arcs;  
Fault Tree Analysis; Hazards; Power Supplies; Safety  
Secondary Keywords: ERDA/700209; Fiber Optics; NTISDE

1349  
(SWITCHES; CLOSING; SAFETY)  
(Gas Gaps; Self)  
OVERVOLTAGE PROTECTION BY POINT-PLANE SPARK GAPS  
W. R. Scarlett and K. B. Riepe  
Los Alamos National Labs, Los Alamos, NM 87545  
LA Report No. LA-UR-79-1655 (10/1979).  
Availability: LA-UR-79-1655  
NTIS  
Electron-beam-controlled discharge CO/sub 2/ lasers, such as those  
used in the Antares and Helios laser-fusion drivers at the Los Alamos  
Scientific Laboratory, need protection against possible damage due to  
overvoltage. A negative point-plane spark gap has been developed and  
successfully used in the Helios power amplifiers which operate at  
voltages up to 300 kV. A gap of similar design is planned for use in  
the Antares power amplifiers which operate at 550 kV. These gaps must  
reliably hold off the normal discharge voltage, but break down with  
a rapid delay if overvoltage, diverting the discharge energy to a  
resistor. A prototype of the Antares gap has been built and is  
undergoing tests. Parameters being investigated include voltage  
polarity, gap spacing, gas composition, and gas pressure. Results of  
these measurements and the operational experience of the Helios gaps  
will be presented. 2 Refs.  
Primary Keywords: Overvoltage Protection; Point-Plane Spark Gap; High  
Voltage; Voltage Polarity Variation  
Secondary Keywords: Gas Laser

1350  
(PULSE GENERATORS)  
(Trigger)  
SIX CHANNEL DIGITAL DELAY GENERATOR  
C. J. Aseltine  
Army Ammunition Research and Development Command, Aberdeen Proving Ground,  
MD 21241  
ARPR Report ARBRL-TR-02013 (01/1980).  
Availability: AD A645575  
NTIS  
A six channel digital delay generator is described which can  
provide delays of 1 microsecond to 10,000 microseconds. Delays are  
digitally generated and are designed to operate in high RFI areas  
such as those encountered in ballistic measurements. 9 Refs.  
Primary Keywords: Delay Generator; Digital Delay Generator;  
Secondary Keywords: Switch X-ray



1351  
(PARTICLE BEAMS, ION)  
(Generation)

STUDY OF THE GENERAL PLASMA CHARACTERISTICS OF A HIGH POWER  
MULTIFILAMENT ION SOURCE

R. F. Schoenberg  
Lawrence Berkeley Lab., Berkeley, CA  
LBL Report No. LBL-8940 (22/1979)  
Availability: LBL-8940  
NTIS

A general assessment of the steady state and time dependent plasma properties which characterize a high power multifilament ion source is presented. Steady state measurements, obtained via a pulsed electrostatic probe data acquisition system, in part include: A) The source electron distribution function consists of a bulk component of thermalized electrons comprising 90 to 95 percent of the total electron population, plus a non thermal high energy tail which is a function of the source energy, and contains a small but experimentally significant electron population at energy values 0 to 15 eV above maximum cathode fall. B) Steady state source performance approximately follows low pressure discharge theory assuming spatially uniform ion production. The multifilament source is presently the heart of the 12 MeV Neutral Beam program, slated to provide neutral beam heating for several MHD fusion experiments. A brief discussion of plasma parameters and the measured source plasma parameters with overall neutral beam performance is included. 1 Ref.

Primary Keywords: Ion Beam; Neutral Beam; Electron Distribution; Functions; High Energy Tail; Low Pressure Discharge Theory; Electrostatic Probe

1352  
(PULSE GENERATORS: POWER CONDITIONING)  
(Capacitive; Pulse Transformers)

SURGE GENERATOR IN THE MEGAVOLT RANGE

V. I. Mikhaylov  
FTD Report No. FTD-IDP51T-1149-79 (03/1979)  
Availability: AD A024552  
NTIS

A pulse generator designed to investigate the dielectric strength of acceleration tubes is described. This pulse generator is based on a capacitive source that is discharged into a pulse transformer with a subdivided core. An analysis is made of a unit designed to produce pulses of up to 1 MV. 3 Refs.

Primary Keywords: Pulse Generator; Pulse Transformer; Subdivided Core; Calculation; Megavolt Pulses  
Secondary Keywords: Accelerator Tube

1353  
(PULSE GENERATORS)  
(Hand Tube)

A VARIABLE LOW FREQUENCY HIGH VOLTAGE GENERATOR USING VALVES WITH FIBRE  
OPTIC LIGHT GUIDE CONTROL

R. Miller, I. A. Black and V. N. Gray  
Brighton Polytechnic, Moulsecomb, Brighton, BN2 4GJ, UK  
Journal Of Physics E: Scientific Instruments, Vol. 8, No. 9, pp 748-750  
(1975)

This article describes a new method of generating low frequency high alternating voltages by modulating two high voltage DC supplies of opposite polarity. The modulation is accomplished by the use of triode valves situated at high voltage whose grids are supplied by control signals transmitted from the control circuit through fibre optic light guides. The first generator built is capable of driving a 1 nF load at 10 kV peak over the frequency range DC-50 Hz, or a 0.1  $\mu$ F capacitor at up to 0.1 Hz. In order to increase the voltage and current ratings of the generator, a series parallel arrangement of valves may be used, with the appropriate control signals fed to the grid of each valve. Because the generator is relatively free from any electrical noise, it can be used to energize insulation samples in connection with partial discharge detection investigations. 8 Refs.

Primary Keywords: Bipolar Output; Capacitive Load; 10KV 1000 PPS; Triode Vacuum Tubes  
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1355  
(POWER TRANSMISSION)  
(Transmission Lines)

CURRENTS AND CHARGES ON CYLINDERS IN A PARALLEL-PLATE TRANSMISSION LINE

T. T. Wu, M. Kneek, R. W. P. King, D. J. Blaser and T. K. Sarkar  
Harvard University, Cambridge, MA  
Final rept. 30 Jun 76-30 Jun 79 (07/1979)  
Availability: AD A079 597/1  
NTIS

The final report summarizes the results of a 3-year model study to evaluate how well a parallel-plate transmission-line structure simulates an electromagnetic pulse with a plane-wave front. The amplitude and phase of the electric field inside the model simulator have been measured at two high frequencies for which transmission-line theory does not apply. An approximate theoretical representation of the field is used to interpret the measured data. Differences between the actual field and the desired traveling plane-wave field are discussed, and possible methods to improve the field in the simulator are offered. (Author)

Primary Keywords: Electromagnetic Pulse Simulators; Electric Fields; Electromagnetic Wave Propagation; Transmission Lines; Metal Plates; Parallel Orientation; Electromagnetic Pulses; High Power; Wavefronts; Plane Waves; Transverse Waves; Waveguides

Secondary Keywords: NTISDDXA; NTISDDBA

1356  
(ELEMENTS OF HIGH-VOLTAGE NANOSECOND PULSE GENERATORS ON COAXIAL CABLES)

P. S. Anan'ev, A. G. Sterligov, V. G. Tolmachev and Y. P. Usov  
FTD, Wright-Patterson AFB, OH  
No. FTD-IDP51T-0374-79, 11p (03/1979)  
Trans. From: Fizika i Elektronika i Avtomatika, No. 2, P. 97 (1972) By: M. J. Fein

Availability: AD A085 825/3  
NTIS

No abstract available  
Primary Keywords: Pulse Generators; High Voltage; Coaxial Cable; Transmission Lines; Transitions

Secondary Keywords: Nanosecond Pulses; NTISDDXA; NTISRUP

1359  
(INSULATION, MATERIAL BREAKDOWN STUDIES)  
(Solid; Plasma)

EXPERIMENTAL RESULTS ON PLASMA INTERACTIONS WITH LARGE SURFACES AT HIGH VOLTAGES

M. J. Pryor  
Lewis Research Center, Cleveland, OH  
No. NASA TM X421, 10p (03/1979)  
Availability: NPO 2244-7  
NTIS

Multifilament power levels for future payloads can be more efficiently generated using solar arrays operating in the kilovolt range. This implies that large areas of the array at high operating voltages will be exposed to the space plasma environment. The results of interactions of these high voltage surfaces with space plasma environments can seriously impact the performance of the payload system. The plasma surface interaction phenomena were studied experimentally in two separate vacuum chambers, a 4.6 m diameter pulsed long chamber and a 20 m diameter by 0.4 m long chamber. The ambient plasma density was approximately  $1 \times 10^{10}$  to  $1 \times 10^{11}$  m<sup>-3</sup>. The solar array panels, each with areas of 100 to 1000 cm<sup>2</sup>, were made of 1.5  $\mu$ m silicon solar panel material. The results of the plasma surface interaction tests showed that for high positive voltages the plasma sheath formed around the panel and the plasma density was reduced. For negative voltages the plasma sheath formed around the panel and the plasma density was increased. The results of the plasma surface interaction tests showed that the plasma surface interaction phenomena were studied experimentally in two separate vacuum chambers, a 4.6 m diameter pulsed long chamber and a 20 m diameter by 0.4 m long chamber. The ambient plasma density was approximately  $1 \times 10^{10}$  to  $1 \times 10^{11}$  m<sup>-3</sup>. The solar array panels, each with areas of 100 to 1000 cm<sup>2</sup>, were made of 1.5  $\mu$ m silicon solar panel material. The results of the plasma surface interaction tests showed that for high positive voltages the plasma sheath formed around the panel and the plasma density was reduced. For negative voltages the plasma sheath formed around the panel and the plasma density was increased. 1 Ref.

Secondary Keywords: NTISDA1

1362  
(BREAKDOWN STUDIES: INSULATION, MATERIAL)  
(Liquid; Dielectric; Liquid)

DISPERSED PARTICLES ON INSULATORS IN TRANSFORMER OIL DUE TO VOLTAGE PULSES

FTD, Wright-Patterson AFB, OH  
No. FTD-IDP51T-0445-79, 33p (04/1979)  
Availability: AD A02 775/0  
NTIS

No abstract available  
Primary Keywords: Electric Discharges; Transformers; Breakdown (Electronic Threshold); Oils; Pulses; High Voltage; Transitions  
Secondary Keywords: NTISDDXA; NTISFNGG

1361  
(PARTICLE BEAMS, ION)  
(Generation)

ACCELERATION OF IONS BY A MODULATED ELECTRON BEAM

V. V. Volkov, A. O. Lyman and M. A. Khizhnyak  
Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Kharkov, USSR  
Soviet Technical Physics Letters, Vol. 1, No. 7, pp 276-277 (07/1975)  
Trans. From: Pis'ma Zhurnal Tekhnicheskoi Fiziki 1, 615-618 (July 1975)

V. I. Veksler's well-known ideas of collective acceleration of charged particles have led to the appearance of a large number of schemes for collective acceleration. In particular, we have proposed to accelerate ions with quasi-static electric fields produced in a straight electron beam of constant diameter propagating a conducting shield whose diameter varies along the system axis. Use is made here of the fact that the potential on the axis of the system increases with increasing ratio of the shield diameter to the electron-beam diameter. If the shield diameter changes periodically, then a sequence of potential wells is produced in the system and the dependence of the longitudinal component of the electric field on z is described by a periodic function. 1 Ref.

Primary Keywords: Collective Acceleration; Shield Diameter; E-beam Diameter; Potential Increase; Shield Diameter Modulation

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1363  
(SWITCHES, CLOSING)  
(GAS)

OPTICALLY ACTIVATED SWITCH

L. K. Lohry  
Westinghouse Research and Development Center, Pittsburgh PA  
AFAPL Report No. AFAPL-TR-76-17 (04/1978)  
Pre-lab report. AD A00 567  
NTIS

There has been a growing need for improved switches for very high energy pulsed power systems. Conventional switches such as thyristors, spark gaps, and ignitrons have deficiencies in one or more of the desired parameters. A new solid state device, the Laser Activated Silicon Switch (LASS), appears to have the potential of meeting simultaneously all of the desired parameters including life and reliability of an extremely fast, high power, pulsed power switch. The LASS is a silicon pnp structure similar to an optically gated thyristor, but it is triggered by a beam from a Nd:YAG laser. The laser trigger causes the device to turn on orders of magnitude faster than does an optically gated device. This report describes the development and experimental verification of an analytical model of a high power LASS. Switches were fabricated and tested that achieved di/dt values greater than 40000 A/microsecond to peak currents of 2500 A for a pulse width of 40 microseconds. It is concluded that the LASS indeed has the potential to meet the needs for a solid power switch. A considerable research and development work is required. Recommendations are given for future work. 46 Refs.

Primary Keywords: Thyristors; Optical Triggering; High Repetition Rate Switches; Laser Activated Silicon Switch; Nd-YAG Laser; Experiments Theory

1364  
(INSULATION, MATERIAL)  
(Solid)  
STUDY OF THE EVOLUTION OF ELECTRICAL TREING BY OBSERVATION OF LUMINOUS PHENOMENA AND DISCHARGE DETECTION

C. Laurent and C. Mayoux  
Toulouse Univ. (France). Lab. de Genie Electrique.  
No. PUBL-361, 6p (04/1978).  
Availability: M80-17374/3  
NTIS

Results obtained from the observation of discharge characteristics for different treing types as well as the time dependent evolution of accompanying light phenomena were studied. The experimental apparatus, consisting of a microscope (400 X) and a camera, are described and the experimental procedure outlined. Results demonstrate the occurrence of light emission due to the existence of discharge under the studied voltage conditions. The evolution of the light in the electrode gap was revealed through the use of an image intensifier. The same aging conditions as those reported in the literature for an air filled gap were also observed.

Primary Keywords: Arc Discharges; Circuits; Light Emission; Microchannels; Microphotographs; Amplifiers; Electric Arca; Imaging Techniques; Insulators; Optical Microscopes; Spark Gaps  
Secondary Keywords: NITINASEE; NITISAFR

1366  
(DIAGNOSTICS AND INSTRUMENTATION, SYSTEMS)  
(Systems)

AUTOMATING THE E-BEAM LASER LABORATORY

P. G. De Biase  
Aerospace Corp., El Segundo, CA 90245  
Interim report No. TR-880594-62-43, 27p (11/1979).  
Availability: AD-829 599/4  
NTIS

Experiments conducted in the E-beam Laser Laboratory require the setting of gas flows, pressures, and voltages in a fixed sequence, with a variety of sensors monitoring the system. The report describes the use of a CRAMP microcomputer and other hardware, and details a BASIC program that senses and displays process variables digitally, reads in process parameters interactively, acquires data during an experiment, and computes and prints out test conditions and results. (Author)

Primary Keywords: Chemical Lasers; Pulsed Lasers; Electron Beams; Trigger Circuits; Experimental Data; Data Acquisition; Computer Applications; Operational Amplifiers; Analog to Digital Converters; Computer Programming; Microcomputers; Mixing; Hydrogen; Fluorine

Secondary Keywords: Marx Generators; Chemical Pumping; Cromenco; Computation; BASIC Programming Language; Computer Applications; NITISODCA; NITISODAF

1371  
(POWER CONDITIONING)  
(Systems)

HIGH POWER STUDY-POWER CONDITIONING

A. S. Gilmour Jr.  
State University of New York at Buffalo, Buffalo, NY 14226  
AFAPL Report No. AFAPL-TR-76-101 (01/1976).  
Availability: AD-838724  
NTIS

This paper summarizes the power conditioning portion of the high power study that was performed for the Air Force Aero-Propulsion Laboratory by the State University of New York at Buffalo. This effort defines the power conditioning system and critical component developments which will be required to interface the airborne 10 MW to 50 MW sources defined under separate study efforts with certain loads. Power conditioning systems are considered for use with magnetohydrodynamic generators and turbine driven alternators, both conventional and superconducting. The critical components required for each of the power conditioning systems are identified and then analyzed. The component analysis includes estimations of development efforts necessary and of specific weights and volumes of components. The primary components considered are transformers, switches, capacitors and inductors. Weight algorithms are developed for each of the components. Following the component analysis, subsystems such as inverters and rectifier and filter packages are considered. The data for the various components and subsystems are then utilized for a comparison of the power conditioning techniques to be used with the various power sources. The weights and volumes of power conditioning systems for 5 point designs (8 variations of power, voltage, duty cycle and total run time) are derived. Finally a development program is outlined for the critical components. 12 Refs.

Primary Keywords: Power Conditioning; High Power; Transformers; Solid State Switches; Capacitors; Inductors; Adiabatic Components  
Secondary Keywords: Inverters; Converters; Light Weight Components

1372  
(DIAGNOSTICS AND INSTRUMENTATION, REVIEWS AND CONFERENCES)  
(Systems, Reviews)

HIGH VOLTAGE DESIGN GUIDE FOR AIRBORNE EQUIPMENT

M. G. Dunbar and J. W. Seabrook  
Boeing Aerospace Co., Seattle, WA 98124  
AFAPL Report No. AFAPL-TR-76-41 (06/1976).  
Availability: AD-829258  
NTIS

This report supplies the theoretical background and design techniques needed by an engineer who is designing electrical insulation for high-voltage high-power components, equipment, and systems on aircraft. A literature survey and abundant bibliography identify references that provide further data on the subjects of partial discharges, corona, field theory and plotting, voids and processes for applying insulation. Both gaseous and solid insulations are treated. Cryogenic and liquid design notes are included. Tests and test equipment for high voltage insulation and equipment are defined. Requirements of test parts and procedures for high-voltage high power equipment are identified and illustrated by examples. Suggestions for high-voltage specifications are provided. Very few of the Military and Government specifications deal with system voltages above 10kV, thus most aircraft high-voltage specifications will have to be derived from the power industry specifications and standards produced by ASTM, IEEE, and NEMA. 12 Refs.

Primary Keywords: Corona; Dielectric Withstanding Voltage; Electrical Insulation; High Voltage; Impulse Voltage; Partial Discharges; Paschen Law; Tracking  
Secondary Keywords: Creepage; Field Theory; Utilization Factors; Test

1373  
(SWITCHES, OPENING)  
(Vacuum Gaps, Magnetic Field)  
INVESTIGATION OF FEASIBILITY OF VACUUM-ARC FAULT-CURRENT LIMITING DEVICE  
A. S. Gilmour Jr.  
State University of New York at Buffalo, Buffalo, NY 14226  
EPRI Report No. EPRI-EL 538 (12/1977).  
Availability: EPRI-EL-538  
EPRI

The feasibility of a vacuum arc fault current limiter was investigated in this project. This work is an outgrowth of the studies on the interruption of DC vacuum arcs that have been underway at the State University of New York at Buffalo for several years. In those studies a magnetic field has been used to interrupt or control the current flow in a vacuum arc device. The configuration of the device is such that electron current is forced to flow primarily radially outward from the end of a relatively small rod shaped cathode to a ring shaped anode. Control is achieved through the application of an axial magnetic field. Operation at current levels in the 5 to 10 kA range have been demonstrated for periods up to about 1 ms. The voltage of operation that has been demonstrated is less than required because of discharge paths that develop within the device in parallel with the desired path from the cathode to the anode. Significant progress was made in eliminating these discharge paths by using insulating shields between the anode and the cathode support structure. A brief study of fault current limiter commutation voltage showed that the voltage appearing across a commutation device could be limited to a very reasonable value if the commutation current waveform was properly controlled. Another study dealt with an investigation of the phenomena occurring during the limitation of arcs on gold and on copper cathodes. 8 Refs.

Primary Keywords: Vacuum Gap; Current Interruption; Magnet c Field; Waveform Control  
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1395  
(ENERGY STORAGE, ELECTROSTATIC)  
(Reviews)

PROGRESS IN RESEARCH ON ELECTROSTATIC GENERATORS

A. M. Bright  
University of Southampton, Southampton, UK  
Static Electrification, Paper 24, RE-25-296 (05/1971).

The requirements for high voltage generators are determined by the demands of physicists, engineers and industry. In this paper a review of the requirements is given, together with the various techniques for designing electrostatic high voltage power supplies. The basic principles underlying the physics of electrostatic generators are considered, enabling one to envisage which method is more suitable for any particular requirement. An analysis of both the insulating carrier machine and the variable capacitor machine is presented with illustrations indicating the limitations and areas for further research to meet specific power densities. The research associated with liquid insulated generators is reviewed, including both polar and nonpolar fluids. Developments are given for those generators using moving rotors with polar liquids (nitrobenzene) and for the streaming type EHD system with nonpolar liquids (hexane). The areas which require more study are the charge injection, charge collection and the associated bulk motion of the liquid. The latest achievements in these areas are presented. In the last section, a novel electrostatic generator employing dust laden air is described. 20 Refs.

Primary Keywords: Basic Principles; Insulating Carrier Generator; Variable Capacitor Generator; Polar Fluids; Nonpolar Fluids; Dust Laden Air  
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1402  
(BREAKDOWN STUDIES)  
(Gas, Electrical)

CONTRIBUTION TO THE THEORY OF IMPULSE BREAKDOWN

F. R. Dickey Jr.  
Harvard University, Cambridge, MA  
Journal Of Applied Physics, Vol. 13, No. 12, pp 1336-1337 (12/1952).

The experiments of R. C. Fletcher on impulse breakdown are discussed and a theory for these experiments is developed by assuming that the breakdown consists of ionization and charge separation in a uniform field. The theory accounts reasonably well for the time lags and also explains the shapes of the breakdown voltage transients. It indicates also that measurement of the mean ionizing time for electrons in the gap should be possible. 3 Refs.

Primary Keywords: Gas Breakdown; Impulse Voltage; Theory; Breakdown Delay; Numerical Calculation  
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1412  
(INSULATION, MATERIAL; ENERGY STORAGE, CAPACITIVE)  
(Solid; Capacitors)

MODIFIED PLZT HIGH VOLTAGE DIELECTRICS  
T. R. Gururaj, S. Kumarakrishnan and E. C. Subbarao  
Indian Institute of Technology, Kanpur, India  
Ferroelectrics Vol. 27, pp 277-280 (01/1980).

Modified PLZT compositions were tested for the variation of their dielectric constant with respect to temperature and DC bias voltage. Calcium, strontium, and barium were added to replace lead and neodymium in place of lanthanum. Yttrium was also used, but it caused the formation of a cubic zirconia phase. A model based on the nearness of a material to the AFE-EE boundary is discussed. 3 Refs.

Primary Keywords: Multilayer Capacitor Dielectric; Dielectric Constant; Variation With Temperature; Variation With DC Bias; Modeling  
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1413  
(ENERGY CONVERSION, ELECTRICAL; ENERGY STORAGE, INDUCTIVE; SWITCHES, OPENING)

CHARGING OF CAPACITORS BY MEANS OF EXPLODING WIRES

L. Liebing  
Institut für Plasmaphysik, Garching, FRG  
Zeitschrift für Angewandte Physik, Vol. 26, No. 5, pp 345-350 (04/1969).

Exploding copper wires are used as circuit breakers in a circuit which discharges a fast energy storage capacitor from an inductive store. A two stage version of this circuit was constructed and tested with good results. Wire explosions confined in glass capillary tubes with inner diameters up to 2 mm were also studied. The load voltages in these experiments was 40 kV, but a discussion of scaling the circuit up to 1 MV is presented. 13 Refs.

Primary Keywords: Pulsed Capacitor Charging; Exploding Wire; Inductive Energy Storage; Two-stage Charging  
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1415  
(PARTICLE BEAMS, ION)  
(Transports)  
A HIGH VOLTAGE DEFLECTION CONDENSER OPERATED UNDER HIGH VACUUM CONDITIONS  
G. Munzenberg (1), M. Faust (1), S. Hofmann (1), H.J. Schott (1) and K. Guttner (2)  
(1) Gesellschaft für Schwerionenforschung, Darmstadt, FRG  
(2) Physik Institut, Universität Giessen, Giessen, FRG  
Nuclear Instruments and Methods 166 (1979), pp 391-395 (12/1979).  
Two electrostatic deflection condensers with plane electrodes of 50x60 cm/sup 2/ surface area are operated under high vacuum conditions up to voltages of 620 kV across a gap of 15 cm. The condensers are operated in parallel by common power supplies. They are installed at the velocity filter SHIP at GSI Darmstadt. 10 Refs.  
Primary Keywords: Ion Acceleration; Automatic Conditioning; Vacuum; Nuclear Reaction Products; Electrodes  
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1421  
(ENERGY STORAGE, CAPACITIVE; INSULATION, MATERIAL)  
(Capacitors, Solid)  
HIGH VOLTAGE POWER CAPACITOR DIELECTRICS RECENT DEVELOPMENTS  
L. Mandelcorn (1), T.W. Dakin (1), R.L. Miller (1) and G.E. Mercier (2)  
(1) Westinghouse Electric Corp., Pittsburgh PA  
(2) Westinghouse Electric Corp., Bloomington, IN 47402  
IEEE Proceedings Of The 14th Electrical Electronics Insulation Conference, Boston, MA, pp 250-255 (10/1979).  
This paper discusses recent, new, important developments and evaluations for capacitor dielectrics. These dielectric fluids are isopropylbenzene, di-2 ethylhexyl phthalate plus trichlorobenzene butylated monochlorodiphenyl oxide phenyl xylol ethane and benzyl neodecylate. The film-paper dielectrics impregnated with these were extensively tested for thermal stability under voltage, and resistance to overvoltages with partial discharges. Considerable attention is now being devoted to practically significant partial discharge testing, to determine service reliability. Also included here is the evaluation of windings where one foil is narrower and folded at the edges to reduce the voltage stress at the foil edges. 9 Refs.  
Primary Keywords: Capacitor Dielectrics; Film-paper Dielectrics; Fluid Properties  
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1428  
(SWITCHES, OPENING)  
(Explosive Fuses)  
EXPLOSIVELY ACTUATED FAST-OPENING SWITCHES FOR VERY LARGE CURRENTS  
R.L. Butler and B.W. Dugan  
Sandia Labs, Albuquerque, NM 87115  
Sandia Report No. SAND77-1438 (11/1977).  
Availability: SAND77-1438  
NTIS  
In a series of eight experiments the authors investigated the use of high explosives to interrupt electric current by fast-opening switch mechanisms. The conducting link in seven of the experiments was a glass-lined plasma-filled cavity that was closed explosively. In the eighth experiment a foam-metal link was driven into the liquid-vapor phase and expanded into a ceramic cavity. Resistance increases and resultant voltage spikes that correspond in time with the particle velocities of the collapsing walls were obtained. However, unknown high-resistance paths prevented voltage gradients greater than 1E5-1E6 V/m. 0 Refs.  
Primary Keywords: Explosive Fuse; Glass Lined Plasma Filled Cavity; Foam Metal Link Ceramic Cavity  
Secondary Keywords: Cylindrical Geometry

1429  
(POWER CONDITIONING)  
(Pulse Forming Networks)  
PFN CHARACTERIZATION AND LIFE TEST  
C.L. Dailey and C.W. White  
TRW Systems Group, Redondo Beach, CA  
AFAPL Report No. AFAPL-TR-75-69 (01/1976).  
Availability: AD A022958  
NTIS  
The feasibility of an integral, high temperature, pulse forming network (PFN) operating at a high pulse rate for a short duration burst has been demonstrated. The dielectric construction of the capacitor consisted of Kapton film and paper impregnated with Monsanto Chemical Co. MS 1489 oil. Litz wire coils were wound on a high temperature foam core and the entire assembly was placed in a stainless steel enclosure. A U-shaped aluminum shield was used between the coils and the case to reduce eddy current heating. An overall weight of approximately 20 pounds for an energy storage density of 600 joules (30 joules per pound) was achieved in a design that operated for 1.5E5 shots at a pulse rate of 250 shots per second in 18 second bursts. The burst duration was limited by heating of the stainless steel enclosure due to eddy currents induced by the coil magnetic field. An aluminum case construction would greatly reduce this effect. 2 Refs.  
Primary Keywords: PFN; Pulse Forming Network; High Energy Density Capacitors; High Energy Density PFNs; High Pulse Rate PFNs  
Secondary Keywords: Integral PFN Design; High Temperature Capacitors

1431  
(ENERGY STORAGE, CAPACITIVE; SWITCHES, CLOSING)  
(Capacitors; Thyristors)  
THE DESIGN OF A REPETITIVELY PULSED MEGAJOULE DENSE-PLASMA FOCUS  
D. Zucker, M. Bostick, R. Gullickson, J. Long, J. Luce and M. Sahlin  
Lawrence Livermore Lab., Livermore, CA 94550  
UCRL Report No. UCRL-51872 (08/1975).  
Availability: UCRL-51872  
NTIS  
This report describes a 1 pulse per second, dense-plasma-focus materials-testing device capable of delivering a minimum of 1E15 neutrons per pulse. Moderate scaling up from existing designs is shown to be sufficient to provide 2E13 neutrons/sq. cm./sec to a suitable target. The average power consumption, which has become a major issue due to the energy crisis, is analyzed with respect to other plasma devices and is shown to be highly favorable. Also discussed is a novel approach to capacitor-bank and switch design with respect to repetitive-pulse operation. 17 Refs.  
Primary Keywords: Capacitor Bank; Staggered-foil Capacitor; Silicon Controlled Rectifier  
Secondary Keywords: Dense Plasma Focus; Liquid-dielectric Switch

1432  
(POWER CONDITIONING)  
(Pulse Transformers)  
A THREE MEGAVOLT TRANSFORMER FOR PFL PULSE CHARGING  
G.J. Rohwein  
Sandia Labs, Albuquerque, NM 87115  
IEEE Transactions On Nuclear Science, Vol. NS-26, No. 3, pp 4211-4213 (06/1979).  
High voltage pulse transformers powered by low voltage capacitor banks have proven to be simple reliable systems for charging pulse forming transmission lines (PFL) up to the one megavolt range. A new transformer has been developed which will operate up to three megavolts in a PFL charging application. This transformer establishes the feasibility of multimegavolt operation and retains the features of compactness and high energy transfer efficiency that has been characteristic of lower voltage systems. This report includes a description of the physical features of the transformer, its electrical characteristics and a discussion of the operational results. 8 Refs.  
Primary Keywords: Air Core Pulse Transformer; Megavolt Range; High Efficiency; Spiral Strip Design  
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1433  
(BREAKDOWN STUDIES)  
(Solid; Electrical)  
CALCULATION OF ELECTRIC FIELD BREAKDOWN IN QUARTZ AS DETERMINED BY DIELECTRIC DISPERSION ANALYSIS  
W.T. Lynch  
Bell Labs, Murray Hill, NJ 07974  
J. Appl. Phys., Vol. 43, No. 8, pp 3274-3278 (08/1972).  
A breakdown field of 1.0E7 V/cm has been calculated using classical theory of electron energy loss. Dielectric dispersion curves were used to relate longitudinal optical phonon modes to electron energy loss via interaction of these two processes. The dominant mode was seen to be the 0.153eV phonon mode. The breakdown calculation is also in good agreement with breakdown fields in SiO/sub 2/, which also has optical modes that are strongly localized. 20 Refs.  
Primary Keywords: Longitudinal Optical Phonon Modes; Electron Energy Loss; Nonrelativistic Electrons  
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1442  
(BREAKDOWN STUDIES)  
(Gas; Electrical)  
FORMATION OF NANOSECOND SPARKS IN STATIC BREAKDOWN OF A GAP  
G.A. Mesyats and G.S. Korshunov  
Tomsk Polytechnic Institute, Tomsk, USSR  
Soviet Physics-Technical Physics, Vol. 13, No. 4, pp 483-487 (10/1968).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 38, 646-654 (April 1968).  
An examination is made of the limits of applicability of relations obtained on the basis of the Rompe-Waizel theory of the spark in static breakdown of air gaps (0.005 to 3.5 cm) under pressures of 1-6 atm, the time resolution of the recording apparatus being 1E-10 sec. It is demonstrated that the experimental results agree well with this theory for spark processes of duration  $t \ll 1E-8$  sec. 0 Refs.  
Primary Keywords: Static Breakdown; Nanosecond Resolution; Rompe-Waizel Theory; Experiment; Theory; Variable Gap Spacing; Variable Pressure; Several Electrode Materials; Air Gaps  
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1445  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
OPTIMIZATION OF A HIGH ENERGY REB GENERATOR AND CONTRIBUTED STUDY OF THE PULSED REB  
C. Pitoiset  
CEA Centre d'Etudes de Valduc, Is-sur-Tille, France  
(12/1977).  
Availability: CEA-R-4894  
NTIS  
The optimization of a high-power electron generator which has been designed and constructed in the Commissariat a l'Energie Atomique Laboratories is described. This device, consists of a Marx generator coupled with a low-impedance coaxial line with liquid dielectric (water), should deliver high power pulses (0.1 TW; 50 ns) in a vacuum diode with a suitable impedance. The report consists of the following parts: the optimization definition and the tests to obtain an optimum for the impedance; the study and realization of a new switch in order to cut off the prepulse; the study of the extracted electron beam and its propagation. The present characteristics are: peak voltage in the diode: 600 kV; peak current in the diode: 273 kA; electron pulse width: 80 ns; beam transported energy: 6.8 kJ (graphite calorimeter); maximum peak power: 0.135 terawatt. (Atomindex citation 09:412075).  
Primary Keywords: Electron Guns; Amp Beam Currents; Beam Extraction; Beam Transport; Diode Tubes; Electric Impedance; Electron Spectra; High-voltage Pulse Generators; Performance; Power Generation; Signals; Simulation; Spark Gaps  
Secondary Keywords: IN FRENCH; ERDA/440300; France; Pulse Generators; NTISINIS; NTISFNFR  
Distribution Restriction: U.S. Sales Only.

1448  
(PARTICLE BEAMS, ION)  
(Generation)  
HIGH-IMPEDANCE ION-DIODE EXPERIMENT ON THE AURORA PULSER  
R.A. Meger (1), F.C. Young (1), A.T. Drobot (1), G. Cooperstein (1), S.A. Goldstein (1), D. Mosher (1), S.E. Graybill (2), G.A. Huttlin (2), K.G. Korris (2) and A.G. Stewart (2)  
(1) Naval Research Lab., Washington, DC 20375  
(2) Merry Diamond Labs, Adelphi, MD 20783  
Journal Of Applied Physics, Vol. 52, No. 10, pp 6084-6093 (10/1981).  
Proton beams with currents >50 kA at 5 MeV in a <160-ns FWHM pulse have been extracted from an ion diode operated on the Aurora pulser. This current corresponds to an efficiency (proton current/total current) of 20%, which compares favorably with numerical simulation. The simulation indicates that the ion current is enhanced over the Child-Langmuir value due to increased electron lifetime in the diode. The proton beam directed onto a LiCl target provides a source of 1.8E12 neutrons/sr/pulse in the forward direction from the <sup>7</sup>Li(p,n)<sup>7</sup>Be reaction. 16 Refs.  
Primary Keywords: Proton Beam; 50 kA Current; 5 MeV Energy; Experiment; Theory; Numerical Calculation  
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1477  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
IMPULSE BREAKDOWN IN THE 1E-9-SEC. RANGE OF AIR AT ATMOSPHERIC PRESSURE  
R. C. Fletcher

Massachusetts Institute of Technology, Cambridge, MA.  
Physical Review, Vol. 78, No. 10, pp 1501-1511 (11/1969).  
The formative lag of spark breakdown has been measured over the range from 0.5 to 52E-9 sec. using transmission line circuits in conjunction with the microscopicalograph. It is found to be a function only of the applied field (independent of gap width) for the shorter times (high fields), but to increase for decreasing gap widths for any longer times (low fields). A calculation of the formative lag is presented which is based on the assumption that it consists mainly of the time for a single electron avalanche to build up a space-charge field comparable with the applied field. This predicts the observed formative lag within the experimental accuracy of the measurements over the entire range used. The increasing times for decreasing gap widths for the longer times is interpreted as the transition from a single avalanche to a multiple avalanche mechanism of breakdown. The critical field where this transition takes place for a given gap width is computed and found to predict the observed critical fields within the experimental accuracy. The good agreement between theory and experiment implies a more reliable prediction than has previously been possible for the critical gap width above which the threshold field is determined by a single avalanche mechanism. A sharp drop in the rate of fall of the breakdown voltage is observed for the shorter times. It is suggested that this may be a change in the mechanism of electron release from the cathode. 11 Refs.  
Primary Keywords: Air Gap; Formative Time Gap; High Fields; Gap Spacing Independence; Low Fields; Gap Spacing Dependence.

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1482  
(SWITCHES, CLOSING)  
(Laser, Optical)

LASER-CONTROLLED SWITCHING

J. P. Bentley (1) and T. J. Davies (2)  
(1) Sandia Lab., Albuquerque, NM 87115  
(2) Ford Inc., Dearborn, MI 48116  
IEEE Journal of Quantum Electronics, Vol. QE-7, No. 9 (09/1971).  
A new type of laser switching is discussed. The laser produces volume ionization in the path of a propagating streamer, increasing its velocity. Supersonic jetting is thereby obtained with pressurized gas switches. 5 Refs.  
Primary Keywords: Laser-Enhanced Switching; Volume Ionization; Streamer Propagation; Velocity Increase; Multichannel Operation.

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1483  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Gas, Electrical; Gas Gaps, Self)  
STATISTICAL STUDY OF NANOSECOND BREAKDOWN DELAY IN NARROW GAS GAPS IN SUPERHIGH ELECTRIC FIELDS

G. A. Mesyats and Yu. I. Bychkov  
Tomsk Polytechnic Institute, Tomsk, USSR  
Soviet Physics-Technical Physics, Vol. 12, No. 9, pp 1255-1260 (03/1967).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 37, 1712-1719 (September 1967).

This paper studies the delay in breakdown  $T_{sub} d$  in narrow air gaps 0.2-0.7 mm long for an electric field strength reaching 1.4E6 V/cm and a rise time of 0.25E-9 sec. A specially developed instrument is used to record automatically a large number of breakdown delay times  $T_{sub} d$  (up to 500-600). The distributions of the number of breakdowns are constructed as a function of  $T_{sub} d$ . It is shown that these distributions have a single maximum when the number of breakdowns is approximately 1E3. The number of maxima in the distribution increases when the number of breakdowns is greater than 1E3. The minimum time  $T_{sub} d$  in the distribution is taken to be the time required for discharge to take place and is about 1-2 orders greater than the time required for the avalanche to increase to its critical size  $T_{sub} d_{crit}$ . When the emission current from the cathode is increased, the formation time decreases to about  $T_{sub} d_{crit}$  because of the ultraviolet light of the spark and scratches on the surface of the cathode. It is shown that even for 6- or 7-fold overvoltages the probability that no electron will appear after breakdown is less than unity. It is also shown that fluctuations in the number of secondary electrons prove to have a considerable effect on the formation of discharge. 10 Refs.

Primary Keywords: Breakdown Delay; Very High Fields; Fast Rise Time; Critical Avalanche Size; Cathode Emission; Air Gap.  
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1485  
(ELECTROMAGNETIC FIELD GENERATION)  
(Magnetic)  
INTERACTION OF CAPACITOR-BANK-PRODUCED MEGAGAUSS MAGNETIC FIELD WITH SMALL SINGLE-TURN COIL

J. M. Shearer  
Lawrence Livermore Lab., Livermore, CA 94550  
Journal Of Applied Physics, Vol. 40, No. 11, pp 4490-4497 (10/1969).  
Experiments on the production of high magnetic fields in single-turn coils by means of high-voltage capacitor banks are described. Fields as high as 3.5 megagauss have been produced. Numerical analysis of the interaction of this field with the metal wall shows that magnetic diffusion and wall compression are the principal interaction phenomena. In addition, experimental and theoretical evidence are presented for the emission of a vapor cloud by the wall into the magnetic field volume. Finally, a simple approximate method for calculating the early time history of the magnetic field and coil motion is shown to give reasonable agreement with experiment. 16 Refs.  
Primary Keywords: 3.5 MG Field; Field-Coil Interaction; Field Diffusion; Wall Compression; Vapor Cloud.

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1499  
(BREAKDOWN STUDIES)  
(Lighting)  
LASER-INDUCED LIGHTNING CONCEPT EXPERIMENT

J. R. Lippert  
AFDL, Wright-Patterson AFB, OH  
AFDL Report No. AFDL-TR-78-191 (12/1978).  
Availability: AD A068497  
NTIS

A program was conducted to gain experience and document progress towards development of a concept for a Laser-Induced Lightning Experiment (LILE). The purpose of the program was to develop a method for triggering natural lightning discharges using pulsed lasers and verify theoretical predictions. The technique shows great promise in shortening the acquisition period for obtaining necessary lightning parameter data needed for more realistic lightning simulation tests and more definitive lightning transient analyses. To achieve the intended objective within the restrictions of availability, an experimental method was designed, a test locally selected, test parameters were defined, test apparatus designed and test implementation selected and demonstrated. Although the required climatic conditions did not develop during the experimental period, all other phases of the program were successfully completed. Plans will be initiated for future experiments. Small scale experiments will be performed to investigate spark gap triggering using laser beams. Laser beam effects on electromagnetic fields and laser power density scaling. 11 Refs.

Primary Keywords: Lightning Triggering; Lightning Transient Analyses

1500  
(PARTICLE BEAMS, ION)  
(Target Interactions)  
MATERIAL RESPONSE TO 500 KEV PROTON BEAMS AT INTENSITIES BELOW 1 CM<sup>2</sup>/SQ CM

T. R. Tucker (1), D. Mosher (1) and D. Hinchelwood (2)  
(1) Naval Research Lab., Washington, DC 20375  
(2) JAGCOR, Inc., Alexandria, VA 22304  
NRL Memorandum Report No. 3663 (07/1979).  
Availability: AD A072416  
NTIS

Stress-wave response of several materials to 500 keV, 1 kA/sq. cm proton pulses was monitored by shadowgraphy and interferometric methods. Results indicated the presence of both direct absorption and interaction plasma effects. Incident beam power densities of about 1 GW/sq. cm are necessary for plasma effects to dominate the interaction. 7 Refs.

Primary Keywords: Pulsed Ion Beams; Stress Waves; Interferometry

1501  
(PARTICLE BEAMS, ELECTRON; PULSE GENERATORS; SWITCHES, CLOSING)  
(INSULATION, MATERIAL; SYSTEMS)  
(Generation; Marx; Gas Gaps; Electrical; Liquid)

SUMMARY OF THE HERMES FLASH X-RAY PROGRAM  
T. M. Martin, K. R. Prestwich and D. L. Johnson  
Sandia Labs., Albuquerque, NM 87115  
Sandia Report No. SC-RR-69-421 (10/1969).  
Availability: SC-RR-69-421  
NTIS

The Hermes program produced significant information in the areas of Marx generator design, flash x-ray tube development, dielectric breakdown, and general flash x-ray machine design. As an outcome of the Hermes program, Hermes II was constructed and is the largest flash x-ray machine presently operating. This report summarizes the results of investigations in the areas mentioned and provides a general knowledge in the operation of megavolt flash x-ray machines which should be useful to the experimenters using these machines. 13 Refs.

Primary Keywords: 18-MV Marx Generator; Blumlein; Postpulse Suppression  
Secondary Keywords: Flash X-ray Machines; Hermes II

1502  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
A LONG PULSE, HIGH-CURRENT ELECTRON GUN FOR E-BEAM SUSTAINED EXCIMER LASERS

W. M. Clark and G. J. Dunning  
Hughes Research Labs., Malibu, CA 90265  
IEEE J. Quant. Electron., Vol. QE-14, No. 2, pp. 126-129 (02/1978).  
A new kind of electron gun is described which has produced 5 microsecond beams at 130 keV and 2 A/mm. Scaling estimates are presented which predict that this gun could operate at 450 keV and 10 A/mm. Beam parameters suitable for pumping excimer laser systems for this application the gun has the advantages that the beam is nearly monochromatic and the pulse widths longer than that possible with other presently used guns. 9 Refs.

Primary Keywords: Electron Gun; High Energy; Secondary Electrons;  
Secondary Keywords: Inerting Discharge; Multiple Wires.  
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1503  
(BREAKDOWN STUDIES)  
(Gas, Alpha Particle)  
PREIONIZATION OF PULSED GAS LASERS BY RADIOACTIVE SOURCE

I. J. Elin  
Los Alamos National Lab., Los Alamos, NM 87545  
IEEE J. Quantum Electronics, Vol. QE-14, No. 2, pp. 75-76 (02/1978).  
An alpha-source of americium 241 is used to preionize transverse dielectric-discharge gas lasers, enhancing the useful pressure range in a variety of gases. Of particular interest is the enhancement in electron-attaching gases, which corroborates speculations of the role of negative ions in preionization. 11 Refs.  
Primary Keywords: Americium 241; Electron Attaching Gases; Negative Ions.  
Secondary Keywords: Laser Preionization.  
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1505  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Vacuum, Electrical)  
AN INTERNATIONAL COMPARISON OF HIGH VOLTAGE CAPACITOR CALIBRATIONS  
M.E. Anderson, R.S. Davis, D. Petersons and M.J.M. Moore  
National Bureau of Standards, Washington, DC  
Final report, (01/1978).  
Availability PB-296 114/25T  
NTIS

The suitability of a commercially available, compressed-gas-insulated, high voltage capacitor for precise measurement of ac voltages has been examined by national laboratories in the U.S.A. and Canada. The voltage, temperature, and pressure dependences and the mechanical stability of the capacitor were determined. It was found that, by taking proper precautions, the device is competitive with other methods. As a result of this research, it was also found that high voltage capacitance measurements of the two laboratories involved are in agreement.

Primary Keywords: Capacitors; Calibrating; Comparison; High Voltage; Standards  
Secondary Keywords: AC; AC/DC; NISTCOMBNS  
D Distribution Restrictions: PUB. IN IEEE (INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS) TRANSACTIONS ON POWER APPARATUS AND SYSTEMS PAS-97, No. 1217-1233, JUL/AUG 78.

1508  
(ELECTRIC GENERATORS)  
(Switches, Closing; Switches, Opening)  
A HIGH VOLTAGE, HIGH CURRENT NANOCSECOND PULSE GENERATOR  
J. R. Jones  
Coulter Electronics Inc., Stamford, CT 06902  
The IEEE International Symposium, pp 1-4 (04/1978).  
A pulse generator designed for the development of a high voltage, high current, nanosecond pulse generator of small volume, low weight, and high efficiency. The pulse generator operates either single pulse or 15 Hz at a pulse width of 100 ns, pulse voltage of 30 kV, 1200 amp pulse is formed by a charging capacitor in a circuit with a triggered spark gap. A ringed choke capacitor converter charges the Blumlein circuit capacitor to 30 kV, by transforming the 25 volt input. Breakdown factors leading to the design approach, problems encountered, and breakdown test results. 2 Refs.  
Primary Keywords: Blumlein Line; Ringed; Charging Circuit  
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1531  
(ENERGY CONVERSION, ELECTRICAL)  
(Charging Circuits)  
COMPUTATIONAL PROCEDURES FOR CHARACTERIZATION OF HIGH VOLTAGE SPARK SOURCES  
A. Scheeline, R.J. Klueppel, D.M. Coleman and J.P. Walters  
University of Wisconsin, Madison, WI  
Applied Spectroscopy, Vol. 32, No. 2, pp 224-238 (04/1978).  
Methods for simulating high voltage spark sources are presented. Complete break patterns are computed given the source parameters. Simulation is accomplished by the calculation of capacitor charging current and voltage as they relate to the output of the high-voltage transformer. A relative error of between 1 and 5% is achieved when the computations are compared to the experimental results. 14 Refs.  
Primary Keywords: Spark Source; Charging Characterization; Simulation; Numerical Calculation; Capacitor Voltage; Charging Waveform  
COPYRIGHT: 1978 SOCIETY FOR APPLIED SPECTROSCOPY

1532  
(SWITCHES, CLOSING)  
(Vacuum Tubes)  
A NEW DESIGN FOR A HIGH-VOLTAGE DISCHARGE TUBE  
L.C. Van Atta (1), R.J. Van De Graaff (1) and M.A. Barton (2)  
(1) Massachusetts Institute of Technology, Cambridge, MA  
(2) American Institute of Physics, New York, NY 10017  
Physical Review, Vol. 53, pp 158-159 (02/1933).  
A description is given of tests with a high voltage pulse of simple rugged design. The tube consists essentially of a filter cylinder extending between the electrodes and evacuated to a pressure of  $4 \times 10^{-6}$  mm Hg during operation. A potential of 300,000 volts could be maintained on a section of tube 53 cm long. In spite of the fact that the voltage was initiated by discharge there was no case of puncture. A simple clear-cut mechanism for the initiation of discharge in vacuum (independent of field currents) is given together with confirming experimental evidence. On the basis there is proposed a method of screening the electrodes to prevent breakdown and permit the application of extremely high voltages to the tube. 3 Refs.  
Primary Keywords: Vacuum Tube; Uniform Field; 300 kV Operating Voltage; Breakdown Mechanism  
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1544  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
AC (50 HZ) AND DC ELECTRICAL BREAKDOWN OF VACUUM GAPS AND WITH VARIATION OF AIR PRESSURE IN THE RANGE  $1 \times 10^{-9}$  -  $1 \times 10^{-2}$  TORR USING OFHC COPPER, NICKEL, ALUMINUM, AND NIOBIUM PARALLEL PLANAR ELECTRODES  
R. Macken and L. Altschuh  
University of Sheffield, Sheffield, UK  
Journal Of Applied Physics, Vol. 46, No. 2, pp 627-636 (02/1975).  
Breakdown potentials of vacuum gaps are measured over a wide range of air pressure using both direct and alternating (50 Hz) applied voltage and employing four different electrode materials. The air pressure is varied in the range  $2 \times 10^{-9}$  -  $2 \times 10^{-2}$  Torr for DC and  $6 \times 10^{-7}$  -  $2 \times 10^{-2}$  Torr for AC applied voltage. OFHC copper, nickel, aluminum, and niobium are used to fabricate the electrodes. It is found that the peak AC breakdown voltage is usually higher than the DC voltage for a fixed electrode separation and a fixed gas pressure. Under certain conditions considerable improvement in the insulating property of the gap can be obtained in semivacuum. The improvement in the breakdown voltage of the gap is considerable and can reach up to 62% in some cases. The high breakdown voltage is attributed to the increased work function of the metal-gas adsorbate system. 62 Refs.  
Primary Keywords: AC Breakdown; DC Breakdown; Vacuum Breakdown; Gas Breakdown; Several Electrode Materials; Variable Gas Pressure; Breakdown Voltage Measurement  
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1546  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
CATHODE- AND ANODE-INDUCED ELECTRICAL BREAKDOWN IN VACUUM  
T. Utsunomiya  
Cornell University, Ithaca, NY 14850  
Journal Of Applied Physics, Vol. 38, No. 7, pp 2989-2997 (06/1967).  
The problems considered are whether the breakdown that occurs between two parallel-plane electrodes in a vacuum is an anode-induced or cathode-induced breakdown and what conditions determine which type of breakdown is dominant. The critical anode power density for an anode-induced breakdown and the critical cathode current density for a cathode-induced breakdown were measured and the experimental results were compared with predictions from theory of heat conduction. An analysis of these experimental results led to a criterion for determining the type of breakdown that predominates as a function of separation between electrodes and of the thermal and electrical conductivities of the material of the electrodes. It was shown that there were four distinct regions of separation: two anode-induced regions, one cathode-induced region, and one transition region of both types. 8 Refs.  
Primary Keywords: Parallel-plane Electrodes; Anode Initiated Breakdown; Cathode Initiated Breakdown; Transition Region; Critical Power Density  
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1556  
(SWITCHES, CLOSING; SWITCHES, OPENING)  
(Gas Gaps, Materials; Gas Gaps, Materials)  
ELECTRODE EROSION BY SPARK DISCHARGES  
F.J. Jones  
University College of Swansea, Singleton Park, Swansea, Wales  
Journal Of Applied Physics, Vol. 1 No. 3, pp. 60-65 (03/1950).  
Diffusion and space charge effects are two important factors in determining the size of electrode hot spots. The author presents an estimate of the area of cathode hot spots based on the phenomena and predicts that current densities of approximately  $16 \text{ A/cm}^2$  are possible in short gaps. Electrode erosion is then estimated using the energy balance of these hot spots with an equilibrium temperature equal to the boiling point of the electrode material. An equation is set up to relate the volume evaporated per spark to the electrode material while neglecting chemical effects. 15 Refs.  
Primary Keywords: Electrode Erosion; Very High Current Densities; Lateral Spread; Diffusion; Space Charge Effects  
Secondary Keywords: Diffusion Equation  
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1557  
(SWITCHES, CLOSING)  
(Gas Gaps, Materials)  
ELECTRODE EROSION IN PULSED HIGH-CURRENT DISCHARGES  
G.S. Balakrishna, V. Kiselev  
Order of Lenin Power Institute, Moscow  
Soviet Physics-Technical Physics, Vol. 11, No. 2 pp. 280-283 (08/1966).  
Experimental and theoretical results are presented relating electrode erosion to total energy passed through the gap. The authors obtain a formula for the amount of material melted at the electrode by assuming a plane heat source at the electrode surface and calculating  $T(x,t)$ , an empirically obtained constant is then used to relate the amount of material eroded to that melted. Comparison with experiment shows agreement to be good above a threshold current defined by the authors. 5 Refs.  
Primary Keywords: Electrode Erosion; Molten Metal; Threshold Current; High Current  
Secondary Keywords: Capacitor Bank Discharge  
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1558  
(SWITCHES, CLOSING; SWITCHES, OPENING)  
(Gas Gaps, Materials; Gas Gaps, Materials)  
ELECTRODE VAPOR JETS IN SPARK DISCHARGES  
C.M. Cundall and J.D. Craggs  
University of Liverpool, Liverpool, UK  
Spectrochimica Acta, Vol. 10, No. 12, pp. 1648-1654 (12/1954).  
The characteristics of electrode vapor jets are reported. Velocities of propagation, luminosity, and total material removed from the electrode are measured using a framing camera, spectrometer, and microbalance. The anode and cathode jets were analyzed for several voltages, currents, and electrode materials. 14 Refs.  
Primary Keywords: Electrode Erosion; Luminosity; Metal Vapor Jets; Geometrical Considerations  
Secondary Keywords: Framing Photography; Spectroscopy  
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1559  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
EXCITATION OF THE SPECTRUM IN A SPARK DISCHARGE  
S. Mandelstam  
P.N. Lebedev Physics Institute, The Academy of Sciences of the USSR, Moscow  
Spectrochimica Acta, Vol. 15, pp. 255-271 (01/1959).  
This paper reports a hydrodynamic theory of the excitation of spectra in a spark channel. The channel is produced in air and is completely ionized, consisting mainly of doubly ionized nitrogen. Gas density is approximately  $3.8 \text{ torr}$ . Ion and electron temperatures are approximately equal at  $40,000$ - $50,000$  degrees centigrade. 27 Refs.  
Primary Keywords: Excitation Spectrum; Shock Wave; Discharge-Arc; Transition Region  
Secondary Keywords: Spectroscopy  
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1560  
(BREAKDOWN STUDIES; INSULATION, MATERIAL)  
(Surface Flashover; Solid)  
NEW DATA ON THE CREEP DISCHARGE AT THE SURFACE OF A DIELECTRIC  
J.S. Brzozko, A. Konarski, A. Wojaszkowski, E. Zukowski and J. Grudziński  
Białystok Div. Warsaw University, Białystok, Poland  
Phys. D, Vol. 8, No. 14 pp L175-L178 (07/1975).  
Dielectric samples immersed in an intense electric field exhibit a creep discharge in the gas near the dielectric surface. The authors present measurements of the energy spectra of varying fields with peak values on the order of  $1.0 \times 10^3 \text{ V/mm}$  and a frequency of 50 Hz. Organic glass and selenite salt were used as samples. High energy discharges were found to occur. 10 Refs.  
Primary Keywords: Creep Discharge; High Energy Discharge; Lichtenberg Figure; Organic Glass; Selenite Salt  
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1561  
(BREAKDOWN STUDIES)  
(Solid; Electrical)  
ON THE THEORY OF ELECTRON MULTIPLICATION IN CRYSTALS

Seitz, F.  
Carnegie Mellon University, Pittsburgh PA 15213  
Physical Review, Vol. 16, No. 8, pp. 1376-1393 (11/1949).  
The authors investigate electron multiplication in strong  
electrostatic fields by means of investigation. Statistical velocity  
fluctuations and few-electron interactions with non-polar lattice  
vibrations are seen to be important in electron multiplications. The  
non-polar interaction appears to make differences between von Hippel  
and French breakdown criteria less important than thought  
previously. 27 Refs.  
Primary Keywords: Electron Multiplication; Non-polar Coupling;  
Statistical Velocity Fluctuations; Import Ionization  
Secondary Keywords: Laser Scattering; Polar Crystals; Non-Polar Crystals  
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1562  
(PARTICLE BEAMS; ION)  
(Reviews)  
OVERVIEW OF HEAVY ION FUSION PROGRAM IN U.S.A.

D. Keefe  
Lawrence Berkeley Lab, Berkeley CA  
LBL Report No. LBL-2519 (02/1978).  
Availability: LBL-2519  
This report provides an overview of the Heavy Ion Fusion Program  
in the U.S. The author begins with a short summary of funding for  
Heavy Ion Fusion and proceeds to discuss briefly the state-of-the-art  
in heavy ion drivers. Advantages are discussed for fusion  
applications. A qualitative description is given of ion accelerator  
technology. 9 Refs.  
Primary Keywords: Heavy Ion; Accelerator Systems Future Plans

1563  
(BREAKDOWN STUDIES)  
(Lightning)  
RECOMMENDED PRACTICE FOR LIGHTNING SIMULATION AND TESTING TECHNIQUES  
FOR AIRCRAFT

J. Philippot  
Culham Lab, Abingdon, Oxfordshire, UK  
UKAEA Report No. CLM - R 163 (05/1977).  
Availability: CLM-R163  
Culham Laboratory, Abingdon Oxfordshire, H.M. Stationery  
Office  
This paper is designed as a guide to simulating lightning effects  
on aircraft. The probable characteristics of lightning are presented,  
along with parameter ranges for duration of stroke, and total energy.  
Waveforms are given for simulating the effects of lightning stroke on  
aircraft components and systems with the most devastating waveforms  
indicated. 9 Refs.  
Primary Keywords: Lightning Simulation; Current Ranges; Duration;  
Simulation Waveforms  
Secondary Keywords: Aircraft Damage  
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1564  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Current)  
SHUNTS AND INDUCTORS FOR SURGE-CURRENT MEASUREMENTS

Park, J.H.  
Journal Of Research Of The National Bureau Of Standards, Vol. 39, pp  
191-212 (09/1977).  
The special requirements that must be fulfilled by a shunt  
intended to be used in surge-current measurements are explained. A  
tubular shunt with coaxial potential leads that meets these  
requirements is described, and factors affecting its design are  
discussed. A theoretical derivation of the 'skin effect' in this type  
of shunt at high frequencies is given in one of the appendices. The  
advantages of using a mutual inductor for obtaining oscillograms of  
the rate of change of current during a surge are outlined, and  
several types of mutual inductors developed especially for this  
purpose are described. Theoretical derivations, given in the  
appendices, indicate that the concentric-tube mutual inductors  
described in this paper can be used to measure the high-frequency  
components of a current surge up to 70 megacycles with less than 10  
percent error. Several shunts and mutual inductors of the designs  
described in this paper were constructed for use in the high voltage  
laboratory at the National Bureau of Standards. Their complete  
description and oscillograms showing results obtained with them are  
included. 7 Refs.  
Primary Keywords: Pulse Current; Shunt; Current Transformer; Low  
Inductance; Coaxial Shunt; Mechanical Force; D/D-  
Measurement

1565  
(BREAKDOWN STUDIES)  
(Lightning)  
SIMULATION OF LIGHTNING STRIKES TO AIRCRAFT

T.E. James and J. Philippot  
Culham Lab, Abingdon, Oxfordshire, UK  
UKAEA Report No. CLM - R111 (05/1977).  
Availability: CLM-R111  
Culham Laboratory, Abingdon Berkshire, H.M. Stationery  
Office  
The authors report on a feasibility study of lightning testing of  
aircraft. A detailed description of the probable characteristics of  
lightning is presented, along with probable effects on aircraft. The  
design of a pulse generator required to successfully simulate a  
lightning stroke is considered in some detail, with attention given  
to the waveforms of the initial current pulse, voltage gradient,  
swept strokes, and constant current intermediate strikes. 62 Refs.  
Primary Keywords: Lightning Simulation; Lightning Waveforms; High  
Voltage Waveform Generator  
Secondary Keywords: Aircraft Damage; Test Regulations  
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1566  
(PULSE GENERATORS; PULSE GENERATORS; POWER CONDITIONING)  
(Mark; LC Pulse Forming Networks)  
THE POWER BEHIND THE PULSE

M.T. Olson  
Maxwell Labs Inc. San Diego, CA 92123  
Optical Spectra, Vol. 10, No. 12, pp. 42-46 (12/1976).  
This paper is a tutorial on the design and operation of Marx  
generators, L-C generators, and pulse forming networks (PFN) for  
pulsing pulsed gas lasers. Many basic design parameters important to  
all applications are discussed, along with particular problem areas.  
The author stresses that the application engineer should interface  
closely with the designer to avoid potential problems with these  
systems. 6 Refs.  
Primary Keywords: Marx Generator; Blumlein; L-C Generator; Pulse  
Forming Networks; Design Considerations; Pulse  
Transformer  
Secondary Keywords: Laser Loads  
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1568  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Miscellaneous)  
DIGITAL TIMING UNIT FOR IMPULSE GENERATOR CONTROL

R. Minchin (1) and J. Parnell (2)  
(1) Southern Electric Authority of Queensland, Brisbane, Queensland,  
Australia  
(2) University of Queensland, St. Lucia, Queensland, Australia  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-97, No. 3,  
pp. 926-928 (05/1978).  
This paper describes the design and construction of an impulse  
generator control unit which uses the counting of predetermined  
numbers of 10 MHz pulses to fix precise time delays for the control  
of a high voltage impulse generator and its associated recording  
equipment. Facilities for point on wave firing control are also  
provided. Particular attention is paid to problems arising from the  
high noise levels likely to occur in the high voltage laboratory  
environment. 2 Refs.  
Primary Keywords: 10MHz Clock; 300 V Output Pulse; TTL Components;  
10ms Interval; High Noise Environment  
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1576  
(PULSE GENERATORS)  
(Blumlein Lines)  
HIGH AVERAGE POWER PULSER DESIGN FOR COPPER HALIDE LASER SYSTEMS

J.L. Pack, C.S. Liu, D.W. Feldman and J. A. Weaver  
Westinghouse Research and Development Center, Pittsburgh PA  
The Review Of Scientific Instruments, Vol. 48, No. 8, pp 1047-1049  
(08/1977).  
A circuit using two thyretrons is described which provides  
alternating polarity, high-current pulses at pulse repetition rates  
up to 20 kHz, suitable for operating copper halide lasers. The  
circuit is a modification of a Blumlein configuration in which two  
networks are charged in parallel and discharged in series, providing  
a voltage quadrupling effect when used with resonant charging. By  
triggering the thyretrons sequentially the current is reversed on  
alternate pulses, which greatly reduces axial cathaphoretic effects  
and extends the laser tube operating lifetime. The circuit can  
deliver up to 5 kW average power at 15 kHz. 16 Refs.  
Primary Keywords: Bipolar Pulse Generator; Blumlein Line; Resonant  
Charging; Thyatron; Rep-rated  
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PERMISSION

1593  
(ENERGY STORAGE, CAPACITIVE; ENERGY STORAGE, CAPACITIVE; PARTICLE  
BEAMS; ELECTRON)  
(Capacitors; Systems; Generation)  
MAGNETICALLY INSULATED AND INDUCTIVELY CHARGED CAPACITOR FOR THE  
ATTAINMENT OF GIGAVOLT POTENTIALS

F. Winterberg  
University of Nevada System, Reno, NV 89507  
Nuovo Cimento, Vol. 20B, No. 1, pp 173-195 (03/1974).  
The author describes a coaxial capacitor which could be charged to  
a gigavolt. The device employs magnetic insulation, but no  
superconductors are needed. It can be charged inductively and when  
discharged produces an intense electron beam. Scaling laws are  
considered with a view towards a machine several meters in size. The  
design problems encountered in choosing a power supply are also  
discussed. 12 Refs.  
Primary Keywords: Toroidal Capacitor; Very High Voltage; Very High  
Energy; Magnetic Insulation; Inductive Charging  
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1598  
(ENERGY CONVERSION, ELECTRICAL; INSULATION, MAGNETIC)  
(Transformers)  
MAGNETICALLY INSULATED TRANSFORMER FOR ATTAINING ULTRAHIGH VOLTAGES

F. Winterberg  
University of Nevada System, Las Vegas, NV 89109  
The Review Of Scientific Instruments, Vol. 41, No. 12, pp 1756-1763  
(12/1970).  
A high voltage transformer in which a high magnetic field inside a  
hard vacuum insulates against breakdown is proposed. The magnetic  
field is generated by electric currents in high field  
superconductors. Voltages up to 1E9 V may be attainable with such a  
system. A rectifier using high magnetic fields can transform the end  
voltage from AC to DC. The energy output at the terminal of the  
secondary coil can be extracted in the form of either an electron or  
an ion beam through the use of the field emission process. Potential  
applications include (1) high energy particle accelerators with beam  
intensities many orders of magnitude larger than in conventional  
accelerators or meson factories, (2) use in controlled thermonuclear  
fusion devices, and (3) continuous pumping of powerful lasers. The  
feasibility of the system will depend upon depressing the breakdown  
perpendicular to the direction of the high magnetic field. 5 Refs.  
Primary Keywords: High Voltage Transformer; Magnetic Insulation; 1E9 V  
Output; E-beam Generation; Ion Beam Generation  
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PERMISSION

1608  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
ELECTRICAL BREAKDOWN AT VERY LOW GAS PRESSURES  
J.M. Leach  
Queen Mary College, London, UK  
British Journal Of Applied Physics, Vol. 6, pp 107-109 (03/1955).  
Gas discharge phenomena at the pressures used in particle accelerators differ, in general, from those encountered in the normal discharge, since they occur at the pressures for which the mean free paths of the gas particles are comparable with the dimensions of the apparatus. It is the purpose of this note to examine, in terms of atomic collision data, two problems arising in connection with such low pressure discharges. The first problem concerns the validity of a proposed interpretation of an observed breakdown anomaly, the second is to estimate at what pressure breakdown would occur if it were due solely to ionizing collisions in the body of the gas. 6 Refs.  
Primary Keywords: Low Pressure; Long Mean Free Path; Electron Scattering; Paschen Curve Departure  
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1622  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
PULSE ELECTRON ACCELERATOR TO EXCITE LARGE GAS VOLUMES  
B.M. Kovalchuk, V.A. Lavrinovich, V.I. Manylov, G.A. Mesyets and A.M. Rybalov  
Academy of Sciences of the USSR, Tomsk, USSR  
Instruments And Experimental Techniques, Vol. 19, No. 6, pp 1731-1733 (12/1976).  
Trans. From: Priroda i Tekhnika Eksperimenta 6, 125-127 (November-December 1976).  
The description and characteristics of an electron accelerator to produce preionization in the active volume of a CO/sub 2/ laser are presented. The exit window of the accelerator is 30 x 300 cm, the density of the derived electron beam is 2 A/sq cm, for a 2E-6-sec pulse duration and 300-keV electron energy. 3 Refs.  
Primary Keywords: E-beam Generation; Photo Emission Diode; Low Current Density; Large Area Emitter; Pulse Generator  
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1629  
IMPULSE GENERATOR SPECTRUM AMPLITUDE MEASUREMENT TECHNIQUES  
J.R. Andrews  
National Bureau of Standards, Washington, DC  
Final rept. (01/1976).  
Availability: PB-264 328/6ST  
Various techniques that have been used to calibrate impulse generators and to measure spectrum amplitude are surveyed. A summary of experiments comparing the various techniques is included. The NBS measurement service for calibrating impulse generators is described.  
Primary Keywords: Pulse Generators; Spectrum Analyzers; Calibrating; Radiometers; Oscilloscopes; Electromagnetic Interference; Fourier Transformation; Measurement  
Secondary Keywords: Reprints; Spectrum Amplitude; Fast Fourier Transform; NTISCOMNBS  
Distribution Restriction: PUB. IN IEEE TRANS. INSTRUM. MEAS. IM-25, N4 P380-384 DEC 76.

1645  
(PULSE GENERATORS)  
(Blumlein Lines)  
HIGH-VOLTAGE PULSE GENERATOR FOR THE TWO-METER STREAMER CHAMBER OF THE JINR  
N.S. Glogoleva, V.D. Volodin, Yu. Lukstinskii, M.I. Kozlov, Yu.A. Kervashin, P.S. Kuznetsov, A.T. Matvushin, V.F. Matvushin, V.S. Pak, N.S. Rudenko, V.I. Saetenin, V.I. Tsvetkov, A.A. Shatanov, E.A. Shevchenko and A.F. Yudin  
Joint Institute Of Nuclear Research, Dubna, USSR  
Instruments And Experimental Techniques, Vol. 18, No. 5, pp 1439-1440 (10/1975).  
Trans. From: Priroda i Tekhnika Eksperimenta 5, 99-100 (September-October 1975).  
A Blumlein generator with a pulse length which is controllable by changing the middle cylinder of the shaping line is described. The matching load of the generator is 35 ohm; the amplitude instability of the output pulse is 4.1-5.2%. The generator is tested jointly with a working streamer chamber which has two gaps of 30 cm each for an output pulse length of 30.0 and 15.3 nsec. Experimental results obtained during the course of development and testing were presented. 5 Refs.  
Primary Keywords: Pulse Generators; Blumlein Line; Variable Pulse Duration; 35 Ohm Impedance; Performance Test  
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1652  
PRESENT CAPABILITIES OF THE NBS AUTOMATIC PULSE MEASUREMENT SYSTEM  
M.L. Gans  
National Bureau of Standards, Washington, DC  
Final rept. (01/1976).  
Availability: PB-264 331/0ST  
In 1972, NBS began development of an Automatic Pulse Measurement System (APMS) consisting essentially of a minicomputer-controlled wide-band sampling oscilloscope. The objective of the work was to produce a fast general purpose pulse waveform acquisition and processing instrument with spectral capability in the frequency range dc-18 GHz. The purpose of this paper is to report the highlights of work done on the APMS from early 1975 to present. The measurement applications of the APMS now consist of both publicly offered calibration services and in-house experimental measurements. In the first category, calibration services are available for the following physical parameters: (a) Impulse generator spectrum amplitude; (b) Wide-band coaxial attenuation/gain; (c) Pulse generator transition time. Still in the experimental stage are measurements involving reflection coefficient and impedance, group delay, pulse distortion, and wide-band antenna characteristics.  
Primary Keywords: Pulse Analyzers; Automation; Oscilloscopes; Pulse Generators; Measurement  
Secondary Keywords: Reprints; Spectrum Amplitude; NTISCOMNBS  
Distribution Restriction: PUB. IN IEEE TRANS. INSTRUM. MEAS. IM-25, N4 P384-388 DEC 76.

1663  
(PULSE GENERATORS)  
(Systems)  
TWO TANDEM PULSE GENERATORS PROVIDE WAVEFORM FLEXIBILITY  
S. Jacobson  
Caber Electronics Inc, Stamford, CT 06902  
Electronics, Vol. 49, No. 11, pp 118-119 (05/1976).  
The author proposes methods for producing complicated waveforms using two pulse generators connected in series, parallel or tandem. Problems and possibilities for each set up are discussed. 0 Refs.  
Primary Keywords: Bipolar Pulse; Simple Arrangement; Tandem Connection; Series Connection; Parallel Connection  
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1669  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
ELECTRICAL BREAKDOWN BETWEEN METAL ELECTRODES IN HIGH VACUUM. I. THEORY  
F.M. Charbonnier, C.J. Bennette and L.W. Swanson  
Field Emission Corp, McMinnville, OR 97128  
Journal Of Applied Physics, Vol. 38, No. 2, pp 627-633 (02/1967).  
A theoretical description of electrical breakdown across narrow gaps in high vacuum is presented under conditions for which surface cleanliness, work functions, gap geometry, and cathode surface roughness are well defined. Two basic initiating mechanisms are considered: (1) thermal processes initiated at both the anode and the cathode by the prebreakdown field-emitted electron current, and (2) mechanical processes resulting from yield of one of the electrode surfaces under the action of electrostatic stress produced by the electric field in the gap. In the case of thermal breakdown initiation, there exists a boundary between an anode and a cathode-initiated arc which can be expressed in terms of the factor gamma by which the gross field in the gap is enhanced at the tip of microscopic cathode protrusions. Solution of the heat conduction equation is given for the general case of DC or pulse gap voltages. This leads to a distinction between three ranges of pulse duration, and for each region, a simple analytical expression is given for the boundary value gamma/sub 0/ which separates cathode- and anode-initiated breakdown. Based on the considerations presented here, some practical limitations of several electrode materials are given. 21 Refs.  
Primary Keywords: Narrow Gap; Several Electrode Materials; Several Geometries; Variable Surface Roughness; Field Emission; Thermal Processes; Electrostatic Stress; Electrode Deformation; Theory  
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1677  
(INSULATION, MAGNETIC)  
( )  
MAGNETIC INSULATION AND MICROWAVE GENERATION  
E. Ott and R.V. Lovelace  
Cornell University, Ithaca, NY  
Applied Physics Letters, Vol. 27, No. 7, pp 378-380 (10/1975).  
A relativistic equilibrium is found for the magnetic insulation of a diode for conditions where the voltage rise time is long compared to the cyclotron period. Instability of the magnetic insulation equilibrium may allow high-power pulsed microwave generation in magnetronlike configurations. 10 Refs.  
Primary Keywords: High Voltage Diode; Magnetic Insulation; Instabilities; Pulsed Microwave Generation; Magnetron-like Configurations  
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1683  
(PARTICLE BEAMS, ION)  
(Generation)  
PROGRESS IN INTENSE PULSED ION SOURCES  
S. Humphries Jr.  
Cornell University, Ithaca, NY 14850  
Journal Of Vacuum Science And Technology, Vol. 12, No. 6, pp 1204-1207 (12/1975).  
The authors consider the reflex triode as a source of ion beams. The possibility of magnetic insulation, foil anodes, and virtual cathodes are discussed, along with the effect on production efficiency. Several experiments performed at Cornell on ion beam production are reported. 23 Refs.  
Primary Keywords: Reflex Triode; Foil Anode; Virtual Cathode; Magnetic Insulation; High Efficiency  
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1686  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
ELECTRICAL BREAKDOWN BETWEEN METAL ELECTRODES IN HIGH VACUUM. II: EXPERIMENTAL  
C.J. Bennette, L.W. Swanson and F.M. Charbonnier  
Field Emission Corp, McMinnville, OR 97128  
Journal Of Applied Physics, Vol. 38, No. 2, pp 634-640 (02/1967).  
Experiments were performed in order to test the validity of the theory outlined in I. Significant theoretical parameters varied experimentally included electrode material, electrode geometry, and applied voltage pulse length. Electrode materials chosen included W, Mo, Cu, and Al. Gap spacings varied from a few tenths to a few thousandths of a centimeter at gap voltages up to 30 kV applied either continuously or in single pulses of 1 to 100 microsecond duration. For all electrode materials except Al, thermal processes are the primary initiation mechanism, and experimental observations agree with the theoretical predictions of I. With electrode materials of low tensile strength such as Al, the primary cause of electrical breakdown is due to the electrostatic stress produced by the high electric field. 4 Refs.  
Primary Keywords: Several Electrode Materials; Several Electrode Geometries; Impulse Voltage; Variable Pulse Length  
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1692  
(SWITCHES, OPENING)  
(Electrostatic Confinement)  
A SIMPLE HIGH-VOLTAGE OPENING SWITCH USING SPOILED ELECTROSTATIC CONFINEMENT  
I. Alexeff and F. Dyer  
University of Tennessee, Knoxville, TN 37916  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 3, pp 163 (09/1980).  
We have initiated and sustained a plasma discharge at pressures well below the Paschen minimum by trapping electrons in orbits around a positively charged wire. Spoiling the trapping process terminates the discharge and opens the circuit in spite of high voltage applied. 5 Refs.  
Primary Keywords: Opening Switch; Below Paschen Minimum; Charged Wire; Electron Confinement Ground Wire; Discharged Wire; Electron Diffusion  
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1693  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
ELECTRICAL BREAKDOWN UNDER VACUUM CAUSED BY EVAPORATION AT THE ANODE  
I. N. Slivkov  
Soviet Physics-Technical Physics, Vol. 13, No. 8, pp 1131-1132  
(02/1969).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 38, 1385-1387 (August 1968)  
Vacuum insulation works with strong electric fields  $E$ , so such discharges have very high  $E/n$ , where  $n$  is vapor density. Under these conditions, the electron energy is determined mainly by the potential difference through which the electron has passed, not by  $E/n$ . The number of ionizing collisions increases with  $n$ , and the electron energy soon reaches a value such that the ionization cross-section  $\sigma_{ion}/n$  falls as the energy increases further. The gas discharge is therefore most likely to arise in a comparatively small volume directly at the anode, where  $n$  is large. In this paper, this process is compared with other secondary processes previously considered by other workers. 3 Refs.  
Primary Keywords: Parallel-plane Electrodes; High  $E/n$ ; High Electron Energy; Small Discharge Volume; Theory  
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1699  
(INSULATION, VACUUM)  
( )  
PREVENTION OF ELECTRICAL BREAKDOWN IN SPACECRAFT  
F. W. Paul and D. R. Burrows  
Goddard Space Flight Center, Greenbelt, MD  
IEEE Transactions On Electrical Insulation, Vol. EI-6, No. 3, pp 114-123 (09/1971).  
The methods for preventing electrical breakdown problems in space flight are discussed. The techniques that have been evolved by several successful users of high-voltage systems in space are given in considerable detail. The fundamental elements are the avoidance of high electric fields and the avoidance of critical gas pressures. Selection of materials, scrupulous cleanliness, good mechanical design, solid potting or complete venting, and frequent testing are the major steps to success. 5 Refs.  
Primary Keywords: Vacuum Insulation; Cleanliness; Mechanical Design; Geometrical Considerations; Varying Gas Pressure  
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1715  
(INSULATION, MAGNETIC; ENERGY STORAGE, CAPACITIVE)  
(; Capacitors)  
ATTAINMENT OF GIGAVOLT POTENTIALS BY MAGNETIC INSULATION  
F. Winterberg  
University of Nevada System, Reno, NV 89507  
Nature, Vol. 246, No. 5431, pp 299-300 (11/1973).  
The author presents a design for a toroidal machine which can be charged inductively up to one gigavolt. Magnetic insulation keeps the inner conductor separated from the outer conductor. Application of the machine to controlled fusion and collective ion acceleration is discussed. 6 Refs.  
Primary Keywords: Magnetic Insulation; Toroidal Capacitor; Very High Voltage; E-beam  
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1726  
(SWITCHES, OPENING)  
(Explosive Fuses)  
NETWORK FOR FAST COMMUTATION OF LARGE CURRENTS IN AN INDUCTIVE STORAGE DEVICE  
V. G. Artyukh, L. G. Lisenko and S. A. Smirnov  
Academy of Sciences of the Ukrainian SSR, Khor'kov, USSR  
Instruments And Experimental Techniques, Vol. 15, No. 1, pp 130-131  
(02/1972).  
Trans. From: Pribury i Tekhnika Eksperimenta 1, 119-120 (January-February 1972).  
A network for commutating a current of up to 25 kA by means of an exploding wire is described. The instant of commutation is established with an accuracy of up to tenths of a microsecond and is independent of the wire cross section and of the magnitude of the compensated current. 4 Refs.  
Primary Keywords: Exploding Wire; Inductive Energy Storage; Switch System; Triggered Opening Switch  
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1727  
(SWITCHES, OPENING)  
(Thyatron, Electrical)  
MECHANISM FOR NANOSECOND GRID CUTOFF OF HIGH-CURRENT DISCHARGES  
I. I. Bekasov  
Soviet Journal Of Plasma Physics, Vol. 6, No. 1, pp 119-121 (02/1980).  
Trans. From: Fiz. Plazmy 6, 206-210 (January-February 1980).  
Discharge currents of hundreds of amperes can be cut off in a few nanoseconds by a grid in a thyatron with a cutoff device (at average current densities up to approximately 1000 A/cm<sup>2</sup> through the grid). The density of the hydrogen plasma near the grid just before cutoff is estimated to reach  $1E15$  cm<sup>-3</sup>. The negative potential applied to the grid by the cutoff device is 1-2 kV during the cutoff. The effective range, even at these high grid potentials, is much smaller than the grid cell in a plasma of this density, so that the cutoff cannot be attributed to the effect of the grid potential on the discharge. 9 Refs.  
Primary Keywords: Thyatron; Grid Structure; Current Cutoff; Discharge Contraction; Nanosecond Time Scale  
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1728  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
MECHANISM OF DC ELECTRICAL BREAKDOWN BETWEEN EXTENDED ELECTRODES IN VACUUM  
D. K. Davies and M. A. Biondi  
Westinghouse Research and Development Center, Pittsburgh PA  
Journal Of Applied Physics, Vol. 52, No. 8, pp 3089-3107 (07/1971).  
A description is given of vacuum breakdown between extended copper electrodes in DC electric fields in terms of the relevant atomic-collision processes. The theory is based on a model involving avalanche amplification of current in electrode vapor generated by the evaporation of an anode macroparticle during its transit to the cathode. Calculations are presented of the dynamics, heating, and evaporation of the macroparticle leading to the production of the vapor medium in the interelectrode gap. The inferred copper vapor density distribution accounts quantitatively for the absorption of resonance radiation measured just prior to current amplification in the gap. Calculations of electron avalanche multiplication in the vapor lead to predictions of breakdown conditions in agreement with our observations. The predicted size of the anode macroparticle which initiates breakdown is, on the average, of the order of 1 micron in diameter. 55 Refs.  
Primary Keywords: Copper Electrodes; Extended Electrodes; DC Breakdown; Atomic-Collision Process; Theory  
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1729  
(INSULATION, MAGNETIC)  
( )  
ON THE CONCEPT OF MAGNETIC INSULATION  
F. Winterberg  
University of Nevada System, Las Vegas, NV 89109  
The Review Of Scientific Instruments, Vol. 43, No. 5, pp 814-815 (05/1972).  
In a reply to a recent Note by Hirsch [Rev. Sci. Instrum. 42, 1371 (1971)], the several conditions for the feasibility of magnetic field insulation are presented. These conditions are quite similar to those to be satisfied for the magnetic confinement of an electron cloud. 5 Refs.  
Primary Keywords: Feasibility; Simple Geometry; Dust Particles  
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1736  
(SWITCHES, OPENING)  
(Explosive Fuses)  
COMMENTS ON THE LIQUID-METAL MODEL FOR THE CALCULATED ELECTRICAL RESISTIVITY OF AN EXPLODING COPPER WIRE  
A. J. Greenfield and N. Wisser  
Bar Ilan University, Ramat-Gan, Israel  
Physical Review B, Vol. 1, No. 10, pp 4186-4187 (05/1970).  
An argument is presented against the use of a liquid-metal model in computing the resistivity of an exploding wire. Calculations done by the authors show as much as an order of magnitude difference between liquid-metal model predictions and experimental data. 6 Refs.  
Primary Keywords: Exploding Wire; Liquid-metal; Pseudopotential; Charge Distribution; Calculation  
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1741  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
EXPLODING WIRE PARTICLE SIZE BY LIGHT SCATTERING MEASUREMENT  
F. N. Weber and D. D. Shear  
Army Avramet Research and Development Command, Aberdeen Proving Ground, MD 21065  
No. BR-1403, 26 (06/1968).  
Availability: AD-673 710  
NTIS  
The reddish color seen in photographs of exploding copper wires was assumed to be due in part to the scattering of the blue and green wavelengths of the Hg<sub>2</sub> mercury lamp used. Accordingly, this scattered light was used to measure particle size by the dissymmetry method. The average value of the predominant particle dimension was found to be time dependent with a value of 1200 Å occurring .6 usec before the voltage peak. (Author)  
Primary Keywords: Exploding Wires; Vaporization; Rayleigh Scattering; Particle Size; Mathematical Analysis; High-speed Photography; Voltage; Optical Instruments

1743  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
EXPLOSION OF BARE AND INSULATED COPPER WIRES  
B. K. Bhat and I. B. Jordan  
Laval University, Quebec, Canada  
Journal Of Applied Physics, Vol. 42, No. 2, pp 809-814 (02/1971).  
8 Refs.  
Primary Keywords: Bare And Insulated; Condenser Bank Discharge; Insulation Effects; Restrike Current; Restrike Delay; Explosion Zones In Voltage Length Plane  
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1745  
(BREAKDOWN STUDIES; SWITCHES, OPENING)  
(Exploding Wires; Explosive Fuses)  
LIQUID-COPPER RESISTIVITY  
N. Ben-Yosef and A. G. Rubin  
AFRL, Bedford, MA 01730  
Physical Review Letters, Vol. 23, No. 6, pp 289-290 (08/1969).  
The authors present experiments done measuring liquid copper resistivity and calculations done using both a classical plasma approach and Ziman's theory of resistivity of liquid metal. The classical approach failed to adequately explain the experimental results, while close agreement was found using Ziman's theory with a structure factor based on the hard-sphere model. 7 Refs.  
Primary Keywords: Liquid Copper; Resistivity; Degenerate Electron Gas; Ziman's Theory  
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1750  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
TEMPERATURE OF THE RESTRIKE CHANNELS OF EXPLODING WIRES  
S. Lundqvist and A. E. Vlasov  
Institutet For Hopspanningsforskning, Uppsala, Sweden  
Journal Of Applied Physics, Vol. 41, No. 12, pp 4830-4835 (11/1970).  
13 Refs.  
Primary Keywords: Restrike Channel; Plasma Temperature; Thermal Conductivity; Electron Density; Fully Ionized; Uniform Current Distribution  
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1753  
(SWITCHES, CLOSING)  
(Reviews)  
SOVIET RESEARCH AND DEVELOPMENT OF HIGH-POWER GAP SWITCHES

S. Kasal and G. Hendriks  
RAND Corp., Santa Monica, CA 90406  
ARPA Report No. R-1333-ARPA (01/1974).  
Availability: AD A004599  
NTIS

The Tomsk Polytechnical Institute and the Institute of Atmospheric Optics of the Siberian Department of the Academy of Sciences, USSR, have been engaged in the comprehensive research and development of high-pressure gap switches for high-current electron accelerators. The work involves the establishment of broad theoretical foundations for the understanding of the physical phenomena associated with the structure and operation of gap switches. Specification of the optimum operating characteristics, such as current rise time of a fraction of a nanosecond, and construction of prototypes. The theory based on the avalanche-breakdown principle specifies alternate modes of discharge behavior depending on the quantity of initiating electrons, applied field, gap width, and gap pressure. Triggered gap structures incorporating BaTiO<sub>3</sub>/sub 3/ ceramics were built; these are capable of delivering pulses ranging in length down to 0.6 nanosecond and of maintaining pulse repetition frequencies of the order of kHz for peak currents in the kA range. Multi-electrode air-spark gaps for accelerator power sources have also been developed for 100-kA currents with a jitter of less than 5 nanoseconds and without the necessity to adjust gap length. 11 Refs.

Primary Keywords: Gas Gap Switch; Parallel Switch; Multichannel Switch; Fast Switch  
Secondary Keywords: Relativistic-Charged-Particle Beams

1767  
(ENERGY STORAGE, INDUCTIVE; SWITCHES, OPENING)  
(Reviews: Reviews)

J.K. Burton, D. Conte, R.D. Ford, W.M. Lubton, V.E. Scherrer and I.M. Vitkov tsky  
Naval Research Lab, Washington, DC 20375  
2nd IEEE International Pulsed Power Conference Proceedings, pp 284-286 (06/1979)

Recent progress in the development of key elements of high power inductive storage systems makes it possible to generate high power pulsed using energy storage systems (other than explosive generators) that include single-pulse inductive systems, hybrids (inductor/pulse line and inductive devices for steepening of the capacitor output) as well as inductive systems for generation of high power pulse trains. Prospects for further development of opening switches and storage systems suggest potential near-term payoff. Improvements based on such developments can be expected to impact system efficiency, compactness and operational convenience. 15 Refs.

Primary Keywords: Opening Switches; Pulse Compression; Rep-rated; Switch Performance Comparison  
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1768  
(ELECTROMAGNETIC COMPATIBILITY)  
(Hardness)

INTERNAL SCMP AND ANALYTIC REPRESENTATIONS FOR THE SKYNET STRUCTURAL MODEL

R. Stettner and R.M. Marks  
Mission Research Corporation, Santa Barbara, CA 93102  
IEEE Transactions On Nuclear Science, Vol. NS-26, No. 6, pp 4970-4976 (12/1979)

Internal excitation data from the Skynet exploding wire experiments have been compared with finite difference code particle pushing calculations. Comparison between data and calculations was, for the most part, within the expected uncertainty except for two sensors located in the same section of the satellite. For those two sensors a modeling discrepancy in this satellite section may be the source of disagreement. A simple model circuit model is shown to have very nearly the same electromagnetic character as the finite difference code model (and presumably the Skynet Structural model) for a realistic external excitation. Driver models for internal p-dot drivers are suggested. When these models are coupled with the circuit model they agree quite well with the corresponding p-dot driver or the finite difference code 5SM mode. 7 Refs.

Primary Keywords: Exploding Wire Radiator; Response Data; Finite Difference Code Model; Source Charge Limiting; Model Circuit Model

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1770  
(SWITCHES, CLOSING)  
(Liquid Gaps, Self)

LOW PREPULSE, HIGH POWER DENSITY WATER DIELECTRIC SWITCHING

D.L. Johnson, J.P. Vandevender and T.M. Martin  
Sandia Labs, Albuquerque, NM 87115  
2nd IEEE International Pulsed Power Conference Proceedings, pp 191-194 (06/1979)

Prepulse voltage suppression has proven difficult in high power, high voltage accelerators employing self-breakdown water dielectric switches. A novel and cost effective water switch has been developed at Sandia laboratories which reduces prepulse voltage by reducing the capacity across the switch. This prepulse suppression switch causes energy formerly stored in the switch capacity and dissipated in the arc to be useful output energy. The switching technique also allows the pulse forming lines to be stacked in parallel and electrically isolated from the load after the line has been discharged. The switch consists of a ground plane, with several holes, inserted between the switch electrodes. The output line switch electrodes extend through the holes and face electrodes on the pulse forming line (PFL). The capacity between the PFL and the output transmission line is reduced by about 80 percent. The gap spacing between the output line electrode and the hole in the ground plane is adjusted so that breakdown occurs after the main pulse and provides a crow bar between the load and the source. Performance data from the Proto II, Mite and Ripple test facilities will be presented. 5 Refs.

Primary Keywords: Low Prepulse, Reduced Switch Capacitance, Ground Plane, Electrode, Crowbar

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1771  
(PARTICLE BEAMS, ELECTRON; BREAKDOWN STUDIES)  
(Generation; Gas, Electrical)

LOW PRESSURE, HIGH VOLTAGE DISCHARGES FOR THE PRODUCTION OF ENERGETIC ELECTRON BEAMS

J.T. Verdoyen  
University of Illinois, Urbana IL  
ARJ Report No. 12528 I-P (02/1979).  
Availability: AD A074556  
NTIS

The fundamental theories of gas discharges offer widely varying predictions for the relative power input to the negative glow. Calorimetric measurements have been made in a planar helium discharge of the power input to the negative glow relative to the total input power. These measurements show that the limiting efficiency of devices working in this region (e.g. hollow cathode lasers) is approximately 30-40%. To aid in the interpretation of the experimental results a simplified theoretical model was derived. 9 Refs.

Primary Keywords: Gas Discharge Theory; Energetic Electron Beams;

Negative Glow  
Secondary Keywords: Hollow Cathode Lasers

1774  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)

NEW DERIVATION OF THE VACUUM BREAKDOWN EQUATION RELATING BREAKDOWN VOLTAGE AND ELECTRODE SEPARATION

A. Maitland  
University of Manchester, Manchester, UK

Journal Of Applied Physics, Vol. 52, No. 11, pp 2399-2407 (11/1981).  
An analysis of the published measurements of breakdown voltage for various gap lengths for uniform and approximately uniform fields shows that the results may be represented by the breakdown equation  $V = C/\alpha \sup \alpha$  and that the values of  $\alpha$  lie in the range 0.1 to 1.1 with a mode of 0.7. A theory is developed which leads both to a breakdown equation of the same form and to a general expression to account for the range of values of  $\alpha$ . This expression is confirmed for gaps up to 0.375 cm by direct experiment. The development is based on the postulate that an electron beam is emitted from the cathode, diverges, and bombards the anode to cause breakdown when a critical power flux is reached. The factor  $C$  is shown to include the critical power flux and to be related to both field and electrode separation. In support of the theory, the radii of craters produced on the anode are measured and shown to be related to the radius of an electron beam at the anode. Calculation shows the current carried by the beam to be of the order of 1E-4 amp. Values of the critical power flux obtained from the equation  $V = C/\alpha \sup \alpha$  and from anode crater data, respectively, agree within a factor of 1.5 and are of the order of 1E8 W/cm<sup>2</sup>. To explain the observed phenomena, a multiple electron beam system is proposed. 36 Refs.

Primary Keywords: Vacuum Breakdown; Uniform Field; Voltage vs Gap Spacing; Field Emission; Anode Melting

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1776  
(REVIEWS AND CONFERENCES; POWER CONDITIONING; PARTICLE BEAMS, ELECTRON)  
(Reviews: Reviews)

RECENT DEVELOPMENTS IN HIGH AVERAGE POWER DRIVER TECHNOLOGY  
K.R. Prestwich, M.T. Buttram and G.J. Rohwein  
Sandia Labs, Albuquerque, NM 87115  
No. CONF-790723-6, 10p (11/1981).  
Availability: S480-79-0778C  
NTIS

Inertial confinement fusion (ICF) reactors will require driver systems operating with tens to hundreds of megawatts of average power. The pulse power technology that will be required to build such drivers is in a primitive state of development. Recent developments in repetitive pulse power are discussed. A high-voltage transformer has been developed and operated at 3 MV in a single pulse experiment and is being tested at 1.5 MV, 5 kJ and 10 pps. A low-loss, 1 MV, 10 kJ, 10 pps Marx generator is being tested. Test results from gasdynamic spark gaps that operate both in the 100 kV and 700 kV range are reported. A 250 kV, 1.5 kJ Marx exp. 2-30 V electron beam diode has operated stably for 1.6 x 10<sup>6</sup> exp 5 pulses. (ERA citation 04:045158)

Primary Keywords: Inertial Confinement; Power Supplies; Diode Tubes; Performance; Power Transmission; Spark Gaps; Transformer

Secondary Keywords: EPDA/700203; ERDA/700208; NTISDE

1777  
(PARTICLE BEAMS, ELECTRON)  
(Generation)

RIG FOR TESTING COLD CATHODES

E.N. Dmitriyev and V.I. Pershin  
GPAT Atomic Energy Institute, Moscow, USSR  
Availability: IIEF-57(1978)  
NTIS

A rig is described for testing various types of cold cathodes with 1 cm exp 2 area at 600 A total current, intended for use in the linear induction accelerator IU-5/5000, which is an injector of facility for investigation of the collective acceleration method. The rig consists of an electron gun, nanosecond pulse generator, pumping system and beam monitors. Voltage pulses with a 100-120 kV amplitude and 35 ns duration were generated by adiabatic shaping line (DSL), made of 9 cables connected in parallel. The pulses from the DSL were fed in the gun vacuum diode through the transformer-inductor section, increasing the voltage. It is shown that rig is reliable in operation and that the quick replacement is possible in case of cable failure. (Atomizdat citation 10-4525-9)

Primary Keywords: Ion Sources; Beam Monitors; Cathodes; Collective Accelerators; Electron Guns; Flowsheets; High Voltage Pulse Generators; Performance Testing; Pulse Shapers; Spark Gaps

Secondary Keywords: IN RUSSIAN, ERDA/433501; USSR, NTISNIS; NTISFMR  
Distribution Restrictions: U.S. Sales Only

1781  
(ELECTROMAGNETIC COMPATIBILITY)  
(Hardness)

THE EFFECT OF ELECTRON PRECHARGING ON SCMP RESPONSE OF INSULATORS  
V.A.J. Van Lint (1), B.C. Passenheim (1), R. Stettner (1) and D.A. Fromme (2)

(1) Mission Research Corp., La Jolla, CA  
(2) Lawrence Livermore Lab, Livermore, CA 94550  
IEEE Transactions On Nuclear Science, Vol. NS-26, No. 6, pp 5024-5029 (12/1979)  
7 Refs.

Primary Keywords: Exploding Wire Radiator; 5 To 30 keV Electron Precharging; Dielectric; SKYNET Satellite; Enhanced SCMP Response

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1785  
(PARTICLE BEAMS, ION; PARTICLE BEAMS, ELECTRON)  
(Generation; Transport)  
INTENSE RELATIVISTIC ELECTRON BEAM INVESTIGATIONS  
W.D. Daggett  
North Carolina State University, Raleigh, NC 27607  
AFOSR Report No. AFOSR-TR-79-1310 (09/1979).  
Availability: AD A078515

During this period research was performed at North Carolina State on collective ion acceleration in a vacuum diode geometry and in collaboration with a group from the Naval Research Lab on collective ion acceleration within an evacuated dielectric tube. Diode voltage and current wave forms along with transmitted beam energy and current were measured for a series of linear diameters and lengths. Beam energy loss was linear at the rate of approx 12 J/cm. For the 8.3 and 15.9 cm length tubes, the Allen limiting current was exceeded, indicating the creation of enough plasma for some current neutralization. Below the Allen limit the current propagates in a pinched beam. The beam velocity was 1.4 cm/nsec. Equipment for experimental work on electron beam propagation in evacuated magnetized pipes has been assembled and a theoretical study was made of intense electron beam equilibrium in magnetized pipes using a relativistic cold fluid model. 12 Refs.  
Primary Keywords: Collective Ion Acceleration; E-beam Transport; Machine Calibration; E-beam Diagnostics

1795  
(BREAKDOWN STUDIES)  
(Explosion; Wires)  
EFFECT OF STRUCTURAL INHOMOGENEITIES IN EXPLODING WIRES  
V.L. Budovich, G.A. Zaslavskaya, I.S. Kotova and I.P. Kuzhakov  
Moscow Energet. Institute, Moscow, USSR  
Sov. J. Phys. Tech. Phys., Vol. 21, No. 6, pp 681-686 (06/1978).  
Trans. From Zhurnal Tekhnicheskoi Fiziki, Vol. 48, pp 1219-1223, June 1978.  
12 Refs.  
Primary Keywords: Longitudinal Inhomogeneity; Early Melting; MHD; Surface Instability; High Temperature Annealing; Local Melting; Initial Perturbations in Molten Conductor

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1797  
(ELECTROMAGNETIC COMPATIBILITY)  
(Hardness)  
EXPLODING-WIRE PHOTON TESTING OF SKYNET SATELLITE  
D.A. Fromme (1), V.A.J. Van Lint (1), R. Stettner (2), R.W. Macgurn (2) and B.M. Goldstein (2)  
(1) Mission Research Corp., La Jolla, CA  
(2) Mission Research Corp., Santa Barbara, CA  
IEEE Transactions On Nuclear Science, Vol. NS-25, No. 6, pp 1349-1357 (12/1978).  
14 Refs.  
Primary Keywords: Electrical Testing; Photon Testing; Exploding Wires; SKYNET; High Flux; Electromagnetic Response

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1806  
(SWITCHES, OPENING)  
(Explosive Fuses)  
OPTICAL FLASHES FROM DOUBLE WIRE EXPLOSION  
C.Y. Kang, M.H. Lee and S.S. Lee  
Korea Advanced Institute Of Science, Chongyangni, Seoul, Korea  
Canadian Journal Of Physics, Vol. 57, No. 9, pp 1439-1443 (09/1979).  
Two optical flashes are obtained when two wires of different diameters connected in series are exploded. Calculations were done predicting the time between flashes and agreed closely with the experimental results. The flash separation time was found to be controllable depending only on the diameter and composition of the wires exploded. 9 Refs.  
Primary Keywords: Double Wire Explosion; Time Dependent Resistance; Simulation; Numerical Calculation; Optical Flash

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1809  
(INSULATION, MAGNETIC)  
( )  
PROPAGATION OF A MAGNETIC-INSULATION WAVE IN A COAXIAL LINE  
A.V. Gordre  
Soviet Physics Technical Physics, Vol. 23, No. 4, pp 463-465 (04/1978).  
Trans. From Zhurnal Tekhnicheskoi Fiziki, Vol. 48, No. 4, pp 784-788  
7 Refs.  
Primary Keywords: Nonlinear; Vacuum Coaxial Line; Time-dependent; Two-dimensional

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1816  
(ELECTROMAGNETIC COMPATIBILITY)  
(Hardness)  
SPONTANEOUS DISCHARGES AND THE EFFECT OF ELECTRON CHARGING ON SKYNET  
V.A.J. Van Lint (1), D.A. Fromme (1) and J.A. Rutherford (2)  
(1) Mission Research Corp., La Jolla, CA  
(2) IRI Corporation, San Diego, Calif.  
IEEE Transactions On Nuclear Science, Vol. NS-25, No. 6, pp 1293-1298 (12/1978).  
13 Refs.  
Primary Keywords: Electron Implantation; Spontaneous Electric Discharge; E-beam; SGEMP Response; Exploding Wire Radiator; Electric Potential Profile

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1819  
(BREAKDOWN STUDIES)  
(Explosion; Wires)  
THE PHOTOEMISSION SPECTRUM FOR AN EXPLODING WIRE RADIATOR SOURCE INCIDENT ON AL AND AU

D.J. Strickland and D.L. Lin  
Science Applications Inc., Vienna, Virginia  
IEEE Transactions On Nuclear Science, Vol. NS-25, No. 6, pp 1571-1576 (12/1978).  
Rigorous solutions to photoemission for an Al and Au are presented for the first time. The solutions were obtained by solving a Boltzmann transport equation. The results are compared with magnetic spectrometer data by Bernstein and results deduced by Fromme, et al. from backbiased diode data. Except for the spectrometer data for Al, the measured results do not agree well with our calculations. Good agreement, however, is achieved between our results and published data for both photoemission using line sources and for electron backscatter. 15 Refs.

Primary Keywords: Boltzmann Transport Equation; Soft X-ray Spectrum

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1823  
(PULSE GENERATORS)  
(Control Systems)  
A DIGITAL CONTROL SYSTEM FOR HV IMPULSE GENERATORS  
J.E. Matthews and C.Y. Kong  
University of Strathclyde, Glasgow, Scotland  
Journal Of Physics E: Scientific Instruments, Vol. 11, pp 256-258 (03/1978).  
A digital control system using TTL logic elements is described for use with a 1.4 MV impulse generator. The unit is fully programmable and records on magnetic tape the data obtained from breakdown studies of long spark gaps in a form suitable for on-line computer processing. The precautions necessary for operating solid state components in the hostile environment of a high-voltage laboratory include the use of optical links and battery-operated power supplies. 4 Refs.

Primary Keywords: Pulse Generator Control System; TTL Logic Control; Noise Reduction; Circuit Monitoring System  
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1833  
(PARTICLE BEAM, ION)  
(Generation)  
HIGH-CURRENT-PULSED LINEAR ION ACCELERATORS  
S. Humphries Jr.  
Cornell University, Ithaca, NY 14850  
Journal Of Applied Physics, Vol. 49, No. 2, pp 501-512 (02/1978).

Possible methods are described for constructing ion linear accelerators in the 100-MeV range which have pulsed current outputs 10 to 5 times higher than currently available. A drift-tube design with insulating magnetic fields between the tubes is presented. The fields not only prevent electron flow, but also are essential for beam neutralization by low-energy electrons and transverse beam focusing. Preliminary discussions are given on accelerator design and construction, transverse focusing and beam neutralization, and control of the beam in longitudinal phase space. 35 Refs.  
Primary Keywords: 100MeV Range; High Pulsed Current Output (10KA); Insulating Magnetic Field Drift Tube; High Efficiency (20%)  
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1834  
(BREAKDOWN STUDIES)  
(Gas; Optical)  
HIGH-POWER PHOTOIONIZATION-STABILIZED CARBON DIOXIDE WAVEGUIDE LASERS OPERATING AT GAS PRESSURES OF UP TO 13 ATM  
D.J. Brink and V. Hasson  
National Physical Research Lab, Pretoria, South Africa  
Journal Of Applied Physics, Vol. 49, No. 4, pp 2250-2253 (04/1978).  
A simple photoionization-stabilized waveguide laser is energized effectively by fast Blumlein-type pulsed and operates at pressures of up to 13 atm. The laser has an active plasma volume of 0.1 cm<sup>3</sup> up to 37 and provides 20 ns gain-switched pulses with beam energies of 10 mJ. The maximum pressures and beam energies are more than an order of magnitude higher than those published previously; the peak power is enhanced by two orders of magnitude. 13 Refs.  
Primary Keywords: Blumlein Pulsers; High Pressure (13atm); 20ns Pulses; 10ms Beam Energy  
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1867  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
ELECTRON GUN FOR GENERATION OF SUBNANOSECOND ELECTRON PACKETS AT VERY HIGH REPETITION RATE  
M. Weinfeld and A. Bouchoule  
Ecole Polytechnique, Palaiseau, France  
Review Of Scientific Instruments, Vol. 47, No. 4, pp 412-417 (04/1976).  
In order to create and study trapped particle modes in a plasma column, we have designed an electron gun which delivers packets with a duration shorter than 1 nsec at energies of about 100 eV, and with a repetition frequency of several hundred megahertz. This gun is made with parts of a classical disk-sealed microwave triode. This paper describes the gun itself and the pulse generator used to modulate it. Our results concerning trapped particle modes are shown in conclusion. 10 Refs.  
Primary Keywords: Trapped Particle Modes; Magnetically Confined Plasma; Electron Plasma Potential Wells; Disk Sealed Microwave Triodes  
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1868  
(SWITCHES, OPENING)  
(Explosive Fuses)  
EXPLOSIVELY ACTUATED 100 KA OPENING SWITCH FOR HIGH VOLTAGE APPLICATIONS  
R.D. Ford and I. M. Vitkovitsky  
Naval Research Lab, Washington, DC 20375  
NRL Memorandum Report No. 3561 (07/1977).  
Availability: AD A046798  
NTIS

The role of opening switches for high power energy sources such as those required in particle beam research is becoming more important as the prospects for use of inductive storage techniques widens. The technology associated with these switches is also applicable to protection of electric power transmission equipment where continually increasing voltage levels are being sought. A single shot modular opening switch capable of carrying currents up to 100 kA indefinitely and opening in a time of approximately 20 microseconds has been developed. Very low trigger jitter characteristics as well as its simplicity allow the switch to be used both in series and in parallel operation. This switch operates on the principle of an explosively generated pressure which radially drives paraffin to produce multiple ruptures in a cylindrical conductor. Current probes and fast frame photography were used to determine its mechanical performance characteristics such as the reproducibility of the opening time and the simultaneity of the rupturing of the conductor. Current and voltage probes have shown, for example, that a 16-segment switch develops 8 kV in 10 to 20 microseconds in the process of interrupting 100 kA current when used as a safety device, or 110 kV at 40 kA when used with an integral exploding wire fuse. 15 Refs.  
Primary Keywords: High Speed Opening Switch; Inductive Storage  
Secondary Keywords: Current Interrupter; Power Line Protection

1875  
(PRESENT AND CONFERENCES)  
(Reviews)  
PULSED POWER FOR FUSION

T.H. Martin  
Sandia Labs, Albuquerque, NM 87115  
1976 IEEE Pulsed Power Conference Proceedings, Paper ID-1 (11/1976).  
A review which traces the development of high power pulsed accelerators from the original inception at the Atomic Weapons Research Establishment, Aldermaston, England, for Bremsstrahlung output, through the low impedance accelerators, to the doubler-sided accelerators for fusion will be given. Proto II is presently being assembled at Sandia and preliminary testing on the Marx has been completed. Examples of various techniques will be shown from Sandia accelerators. Requirements for accelerators capable of achieving fusion levels will be developed and problem areas outlined. The diode insulator flashover problem presently limits the maximum current available from the accelerators. 15 Refs.  
Primary Keywords: Particle Accelerator; Proto II; Low Impedance; Fast Pulse  
Secondary Keywords: Nuclear Fusion  
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1876  
(ENERGY STORAGE, MECHANICAL)  
(Rotating Machines, Motors)  
PULSED HIGH POWER BRUSH RESEARCH

J.R. McNab  
Westinghouse Research and Development Center, Pittsburgh PA  
IEEE Transactions On Components, Hybrids, And Manufacturing Technology, Vol. CHMT-1, No. 1, pp 30-35 (03/1978).  
The successful utilization of homopolar machines for pulsed power applications requires the development of solid brushes capable of operating at very high current densities and slip ring speeds. Relevant data on the major current collection parameters are reviewed and, where possible, functional variations are suggested. Measured data on voltage drops, friction coefficients and wear rates at current densities up to 27.9 MA/cm<sup>2</sup> (18 kA/cm<sup>2</sup> in.) and slip ring speeds up to 360 m/s in air, hydrogen and carbon dioxide are discussed. 30 Refs.  
Primary Keywords: Homopolar Generator; Solid Brush; Voltage Drop Measurement; Friction Coefficient Measurement; Wear Measurement; Several Atmospheres  
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1881  
(INSULATION, MAGNETIC)  
( )  
MAGNETIC INSULATION

I.D. Smith, P. D'A. Chameney and J.M. Creedon  
Physic International Co, San Leandro, CA 94577  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIC8-1 (11/1976).  
Magnetic insulation of short pulses in vacuum transmission line configurations has been studied analytically since it was successfully used in the AURORA generator. Criteria for its effectiveness have been derived for cases that are steady state and where the load current provides the magnetic field. Experiments are reported here in the 2 to 3.5 MV range. Criteria for insulation have been investigated. Insulation has been demonstrated at applied fields of over 4 MV/cm, and preliminary results obtained for a coaxial line whose double transit time is longer than the pulse duration. 6 Refs.  
Primary Keywords: Magnetic Insulation; Vacuum Transmission Line  
Secondary Keywords: Analysis; Experimental Results  
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1898  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
PURE ROTATIONAL HF LASER OSCILLATIONS FROM EXPLODING-WIRE LASER  
W.M. Rice and R.C. Didenborg  
Los Alamos National Lab, Los Alamos, NM  
IEEE Journal Of Quantum Electronics (March 1977), pp 88-88 (03/1977).  
The report, 19 pure rotational HF laser transitions, 5 of which are new, from exploding-wire, metal atom oxidation lasers. The laser operates at F/sub 2/ pressures as high as 500 Torr and a gain length of only 0.24 m. The laser pulses are 1-4 us duration and deliver 10E-4 J/pulse. 13 Refs.  
Primary Keywords: HF Exploding Wire Laser; 19 Rotational HF Laser Transitions (5 New); F/sub 2/ Pressures Up To 500 Torr; 1-4 Us Laser Pulse Length; 10E-4 J/pulse  
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1907  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
SKIN EFFECT IN EXPLODING-WIRE PHYSICS

P.V. Phung and D.O. Miles  
Lockheed Palo Alto Research Laboratory, Palo Alto, CA 94304  
Journal Of Applied Physics, Vol. 46, No. 10, pp 4487-4492 (10/1975).  
This paper describes a method for calculating the current density in a cylindrical conductor under fast-pulse high-current conditions commonly encountered in exploding-wire studies. Due to extensive Joule heating, the transport property (resistivity-to-permeability ratio) of the conductor must be considered as a varying parameter. Basic mathematical representation of the electrodynamic process is recast into a standard nonlinear diffusion problem. An approximate analytical expression is derived for the penetration depth as a function of time. A numerical solution for the early stages of explosion is also presented for the case of a gold wire in which the permeability is temperature independent and the transport parameter varies only with the resistivity. The effect of magnetic pinch on the solid-liquid transition is not included in this illustrative computation. 11 Refs.  
Primary Keywords: Skin Depth As Function Of Time; Numerical Solution For Gold (Constant Permeability)  
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1926  
(PULSE GENERATORS)  
(Capacitive)  
HIGH VOLTAGE PULSED CIRCUIT FOR DICHRIC STUDIES

H.A. Gluck  
Univ of California, Riverside, CA  
Review Of Scientific Instruments, Vol. 47, No. 1, pp 151-152 (01/1976).  
A high voltage pulse generator using stacks of silicon-controlled rectifiers (SCR's) is described. Pulses of 2 kV are easily produced and applied to solutions for dichroic studies. The system is easily adapted for higher voltage pulses. 3 Refs.  
Primary Keywords: Solid State; SCR Pulse Generator; SCR Switch; Series SCR Switch  
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1927  
(PULSE GENERATORS; SWITCHES, CLOSING)  
(Trigger; Klystrons)  
HIGH-VOLTAGE PULSE GENERATOR OFFERS VARIABLE DELAY AND ONLY 3-NS JITTER  
R.H. Vandre and G.M. Molen  
Aerospace Corp, Los Angeles, CA 90009  
Electronic Design, Vol. 24, No. 9, pp 86 (04/1976).  
The large amount of jitter normally associated with thyatrons is reduced to 3 ns through the use of a cold-cathode tube. The circuit to do this along with some delay circuitry is presented. The generator can produce 4 kV pulses into 50 ohms with a rise time of 10 ns which can be triggered with delays from 0 to 10 microseconds. 0 Refs.  
Primary Keywords: Trigger Generator; Multichannel Delay Generator; Klystron Switch; Delay Logic; Low Jitter; Fast Rise; Low Impedance  
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1937  
(BREAKDOWN STUDIES)  
(Electrodes)  
STABILITY OF FIELD EMISSION AND MIGRATION PROCESSES PRECEDING DEVELOPMENT OF A VACUUM ARC  
G.M. Fursei and G.K. Kartsev  
Leningrad State University, USSR  
Soviet Phys-Technical Physics, Vol. 15, No. 2, pp 225-232 (08/1978).  
Trans. From Zhurnal Tekhnicheskoi Fiziki 40, 310-319 (1970).  
This paper gives the results of an experimental investigation of the migration processes leading to a change in the geometry of the cathode surface and preparing the way for vacuum breakdown. Field emission microscopes - Muller guns with tungsten single crystals - were used for the investigation. The changes in the surface of the tungsten cathode with time in relation to the temperature, residual gas pressure, electric field, and power dissipated by the emitted electron beam on the anode have been investigated. The residual gas pressure was varied from 10 to 5E5 mm Hg, and the temperature from room temperature to 2000 Deg.K. There is a significant relationship between the rate of formation of migrational irregularities on the cathode and the residual gas pressure, cleanliness of surface, and electron beam power in the prebreakdown stage. When the surface remained clean, the processes leading to breakdown are the same in a wide range of pulse lengths (1E-3 - 10 sec). There is a considerable reduction in electric strength of the vacuum gap when the surface is contaminated. The rate of development of breakdown in the stage of transition to a highly conducting vacuum gap is several orders greater than the rate of development of the process in the preliminary stage. 12 Refs.  
Primary Keywords: Field Emission; Migration Process; Cathode Geometry Change; Tungsten Cathode; Variable Temperature; Variable Gas Pressure; Variable E-field; Variable Power Dissipation  
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1946  
(PULSE GENERATORS)  
(Mark)  
BOOTSTRAP CIRCUIT GENERATES HIGH-VOLTAGE PULSE TRAIN

L.H. Barnstater  
Massachusetts Institute of Technology, Cambridge, MA  
Electronics, Vol. 48, No. 14, pp 95-97 (07/1975).  
A 1 kV, 400 Hz pulse generator with a 100 ns rise time is built from 20 low voltage stages. The circuit was to be used in a submillimeter instrument and needs only a low voltage power supply. 0 Refs.  
Primary Keywords: Transistorized Mark; High Voltage; Fast Rise  
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1961  
(PULSE GENERATOR)  
(Miscellaneous)  
PICOSECOND-PULSE SEQUENTIAL WAVEFORM GENERATION  
W. M. Cronson  
Sperry Research Center, Sudbury, MA 01776  
IEEE Transactions On Microwave Theory And Techniques, (December 1975),  
pp 1048-1049 (12/1975).  
This short paper describes a novel method of generating a pulse sequence using step-recovery diodes (SRD's) shunting a transmission line. Individual pulses in the train may have rise times less than 50 ns with amplitudes greater than 10 V. The many potential applications of the device include a short RF pulse generator, and FM generator, and a high-speed word generator. 2 Refs.  
Primary Keywords: Step-Recovery Diodes (SRD's); Shunted Transmission Line; 60ps Risetimes; 10V Amplitudes; N-section  
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1963  
(PULSE GENERATORS)  
(Trigger)  
PULSE AMPLIFIER CAN DELIVER OVER 500 V WITH FREQUENCIES TO 100 KHZ  
D. Limut  
Stanford Research Institute, Menlo Park, CA 94025  
Electronic Design, Vol. 20, pp 102 (09/1975).  
The pulse amplifier presented takes a TTL input and outputs up to 500 volts. The circuit can handle frequencies up to 100 kHz and can drive capacitive loads. 1 Ref.  
Primary Keywords: Data-Converter; TTL Level Input; Simple Design  
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1973  
(PULSE GENERATORS; SWITCHES; CLOSING; SWITCHES; OPENING)  
(Sensitive; Tactitron; Tactitron)  
TACTITRON GENERATOR OF LONG HIGH-VOLTAGE PULSES  
M. Y. Gagin, V. F. Gaidov, V. A. Krestov and A. A. Nikolayev  
Instruments And Experimental Techniques, Vol. 17, No. 6, pp 1568-1669 (12/1974).  
Trans. From: Pribrory i Tekhnika Eksperimenta 6, 102-104 (November-December 1974).  
A generator of long high-voltage pulses is described which uses a tactitron in a self-sustaining discharge mode. An output pulse amplitude of up to 5 kV is achieved. To time-shifted pulses are used to effect continuous variation of the pulse duration in the range from 2 to 100 microseconds. 2 Refs.  
Primary Keywords: Tactitron Switch; Self-Sustaining Discharge; Long Duration Pulse; Two-Pulse Control  
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1977  
(SWITCHES; OPENING; BREAKDOWN STUDIES)  
(Vacuum Gaps; Magnetic Field; Vacuum; Electrical)  
STABILITY OF AC VACUUM ARCS IN TRANSVERSE PULSED MAGNETIC FIELD  
B. L. Rao, S. Linke and R. M. Sudan  
Cornell University, Ithaca, NY 14850  
IEEE Trans Plasma Sci, Vol. PS-4, No. 2, pp 148-152 (06/1976).  
The preliminary results of an experimental study of the effect of an external transverse pulsed magnetic field on the stability of AC vacuum arcs are reported. An air-core coil that will produce magnetic fields of up to 4,000 gauss in the arcing region was designed, built, and tested. The magnetic field is initiated a few hundred microseconds prior to current zero. The magnetic field is found to help in the termination process of the arc and a qualitative explanation is offered for the observed phenomena. 10 Refs.  
Primary Keywords: Vacuum Arcs; Transverse Pulsed Magnetic Field; Arc Interruption  
Secondary Keywords: Electrode Erosion  
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1978  
(PARTICLE BEAMS; ELECTRON)  
(Reviews)  
CIVILIAN APPLICATIONS OF PARTICLE-BEAM-INITIATED INERTIAL CONFINEMENT FUSION TECHNOLOGY  
S. G. Vernado, J. L. Mitchiner and G. Tonos  
Sandia Labs, Albuquerque, NM 87115  
Sandia Report No. SAND77-0516 (05/1977)  
Availability: SAND77-0516  
Electrical power generation by controlled fusion may provide a partial solution to the world's long-term energy supply problem. Achievement of a fusion reaction requires the confinement of an extremely hot plasma for a time long enough to allow fuel burn-up. Inertial confinement of the plasma may be possible through the use of tightly focused, relativistic electron or ion beams to compress fuel pellet. The Sandia Particle Beam Fusion program is developing the particle-beam accelerators necessary to achieve fuel ignition. In this report we review the status of the particle-beam fusion technology development program and identify several potential civilian applications for this technology. We describe program objectives, discuss the specific accelerators presently under development, and briefly review the results of beam-focusing and target-irradiation experiments. Then we identify and discuss applications for the beam technology and for the fusion neutrons. The applications are grouped into near-term, intermediate-term, and long-term categories. Near-term applications for the beam technology include electron-beam (cathode) pumping of gas lasers and several commercial applications. Intermediate-term applications (pellet gain < 50) include hybrid reactors for electrical power production, and medical therapy using ion accelerators. In the long term, complex, high-gain pellets may be used in pure fusion reactors. 66 Refs.  
Primary Keywords: Relativistic E-Beam; Light Ion Beams; Beam Focusing; Water-Dielectric  
Secondary Keywords: Inertial Confinement Fusion; Gas Laser Excitation; ICF Targets

1982  
DESIGN OF A HIGH-VOLTAGE GENERATOR FOR THE FAST IMPLSION-HEATING EXPERIMENT  
J. E. Hammel, I. Henning, J. Marshall and A. R. Sherwood  
Los Alamos National Labs, Los Alamos, NM 87545  
No. CONF-81114-37, 4c (01/1975)  
Availability: LA-UR-75-1752  
For abstract, see NSI 29 Oct. number 14459.  
Primary Keywords: Toroidal Theta Pinch Devices; Plasma Heating; Pulse Generators; Specifications; Compression; Implosion  
Secondary Keywords: AEC

1990  
(REVIEWS AND CONFERENCES; ENERGY STORAGE; PULSE GENERATORS; SWITCHES)  
(Reviews; Reviews; Reviews; Reviews)  
GENERATION OF ULTRA-HIGH POWER ELECTRICAL PULSES  
L. Birenbaum and A. Levi  
Polytechnic Institute of New York, Brooklyn, NY 11201  
RADC Report No. RADC-TR-74-119 (05/1974).  
Availability: AD 761114  
NTIS

This report is a comprehensive assessment of the state-of-the-art of various energy conversion techniques involving high power electrical pulse generation. The subjects treated include rotating machines, explosive devices, superconductivity, switching, and plasma techniques, including the supercritical temperature and pressure regions. 131 Refs.  
Primary Keywords: Superconducting Compounds; Electromagnetic Radiation; Electrical Machinery; Electrical Power Conversion; Device; Pulse Generator; Energy Storage; Switch; Flux Compression; Capacitor; Inductor  
Secondary Keywords: Microwave Generation; RF Transmitter; Nuclear Power Source

1991  
(PULSE GENERATORS)  
(Mark)  
GENERATORS PRODUCING VOLTAGE FOR A TRANSVERSE DISCHARGE  
V. N. Izhmchenko, V. N. Litsyn and V. N. Starinskii  
Institute Of Semiconductor Physics, Academy of Sciences of the USSR, Novosibirsk, USSR  
Instruments And Experimental Techniques, Vol. 17, No. 3, pp 747-749 (06/1974).  
Trans. From: Pribrory i Tekhnika Eksperimenta 3, 108-110 (May-June 1974).  
A series of pulsed voltage generators has been developed operating at voltages of 10 to 70 kV and an energy of 1 to 10 J which are based on low-inductance K15-10 capacitors and gas-filled spark gaps. The construction of the pulsed voltage generators ensures a rate of current growth in a low-resistance load amounting to approximately 1E13 A/sec and a repetition frequency of up to approximately 1E2 Hz. 5 Refs.  
Primary Keywords: Pulse Generator; Modular Construction; Mark Generator; Spark Gap; Repetition; Low Energy  
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2002  
(SWITCHES; CLOSING)  
(Gaps; Optical)  
STARTING HIGH-VOLTAGE GENERATORS AT A VOLTAGE OF UP TO 1 MV BY MEANS OF PULSED X RADIATION  
V. A. Davidenko, B. A. Dolgoshein, A. N. Lebedev, S. V. Somov and V. N. Staroseltsev  
Moscow Engineering-Physics Institute, Moscow, USSR  
Instruments And Experimental Techniques, No. 3, pp 753-755 (05/1974).  
Trans. From: Pribrory i Tekhnika Eksperimenta 3, 113-115 (May-June 1974).  
The possibility was investigated of firing a high-voltage spark gap by means of x radiation. It was shown that such firing may be accomplished at voltages of up to 500 kV, the dependence of the efficiency of x-ray firing on the interelectrode distance of the gap and a rise time of the voltage across it was studied. A circuit was proposed for using such a spark gap in voltage generators rated up to 1 MV. 7 Refs.  
Primary Keywords: Spark Gap; X-ray Triggering; Parameter Study; Interelectrode Distance; Voltage Rise Time  
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2003  
(PULSE GENERATORS)  
(Miscellaneous)  
SUBNANOSECOND RISE TIME PULSES FROM INJECTION LASERS  
J. Vandermill, W. Hafferty and Z. Sztankay  
Harry Diamond Labs, Washington, DC 20438  
IEEE Journal Of Quantum Electronics, (July 1974), pp 570-572 (07/1974).  
The hybrid integration of an injection laser with a simple avalanche transistor modulator is shown to produce optical peak powers of several tens of watts magnitude and pulse rise times appreciably shorter than 1 ns. In certain circumstances the pulse leading edge assumes the form of a spike having a displayed rise time of 120 ps. 11 Refs.  
Primary Keywords: Avalanche Transistor Modulator; Motorola 2N1507 Transistor Chip  
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2007  
(BREAKDOWN STUDIES)  
(Gas; Electrical)  
TUBULAR PULSE-DISCHARGE LAMPS AS CIRCUIT ELEMENTS  
V. A. Ivanov, E. B. Gendachov, V. Intugenov, V. Kalinin and V. Sergeev  
Affiliation Not Given  
Soviet Journal Of Quantum Electronics, Vol. 4, No. 5, pp 656-657 (11/1974).  
Trans. From: Kvantovaya Elektronika, Vol. 1, pp 1195-1200  
The results are given of an experimental investigation of the load characteristics of pulsed-xenon lamps with a luminous channel of 16 mm diameter. A description is given of the method of calculation and the operating conditions of such lamps in a CLR series circuit. 9 Refs.  
Primary Keywords: Tubular Xenon Flashlamps; 16mm Diameter; CLR Series Circuit; 240mm Discharge Length; Reflection Effects  
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2008  
(PULSE GENERATORS)  
(Time Type)  
RECTANGULAR PULSE GENERATOR WITH NANOSECOND RISE TIME  
R. D. Gennaro and C. Blackburn  
Harry Diamond Labs, Washington, DC 20438  
Review Of Scientific Instruments, Vol. 45, No. 12, pp 1546-1549 (12/1974).  
A system is described for producing rectangular pulses up to 300 kV in amplitude with rise times of about 1 nsec and pulse widths adjustable between 5 and 20 nsec. A coaxial line is pulse charged from a Martin-type autotransformer and then discharged by a fast-rise high pressure switch into a matched C507-sub 47 load resistor. A low inductance, resistive voltage divider allows monitoring of the pulse. The pulse reproducibility is excellent and the low jitter (250 nsec) in the discharge switch allows synchronization with other events. The system has been in use for two years with satisfactory results. 9 Refs.  
Primary Keywords: 300 Kv Rectangular Pulse; 1ns Risetime; 198 Ohm Load; 20ns Pulse Width; Coaxial Charge Line; Pulse Chord; Martin Type Autotransformer  
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2013  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
ELECTRICAL BREAKDOWN IN A COLD CATHODE VACUUM DIODE  
D. Milton  
Sandia Labs, Albuquerque, NM 87115  
IEEE Transactions On Electrical Insulation, Vol. EI-9, No. 2, pp 68-80  
(1974)  
A 50-nsec pulse generator is used to obtain time-correlated current-voltage relationships in the prebreakdown region for a long vacuum gap with cold planar electrodes. Analysis of data indicates several sequential stages occur. These stages include an initial quiet stage of voltage increase without interelectrode current, a microdischarge stage, a field emission stage, a space-charge controlled stage, and a final four-microsecond stage where the current becomes sustaining. Electrical breakdown of the gap is considered in terms of a positive ion front moving from the anode. 37 Refs.  
Primary Keywords: Various Breakdown Stages; Microdischarges; Monotonic Current-field Emission; Sustaining Current; Electrical Breakdown  
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2018  
(PULSE GENERATORS)  
(Miscellaneous)  
GENERATOR PRODUCING TRAINS OF HIGH-VOLTAGE PULSES IN THE NANOSECOND RANGE  
I. Ya. Timoshin (1) and E. I. Kolobanov (1)  
(1) Institute Of Nuclear Physics, Academy Of Sciences of the USSR, Novosibirsk, USSR  
Instruments And Experimental Techniques, Vol. 17, No. 1, pp 107-109  
(1974)  
Trans. From: Priroda i Tekhnika Eksperimenta 1, 101-103 (January-February 1974)  
A generator is described which produces rectangular pulses having a length of approximately 10 nsec and an amplitude of up to 4 kV across a 50-ohm load, a repetition frequency of approximately 10 MHz within the pulse train, and a length of the pulse train approximately 100 microseconds with a train repetition frequency of 1 to 5 Hz. 3 Refs.  
Primary Keywords: Pulse Generator; 4 kV Output; Repetition; Burst Mode; 10 MHz Repetition Rate; 100 Microsecond Burst; Ferrite Poking Lines; Thyatron  
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2021  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
THE FIELD EMISSION INITIATED VACUUM ARC. I. EXPERIMENTS ON ARC INITIATION  
M.P. Dyke, J.K. Trolan, E.E. Martin and J.P. Barbour  
Linfield College, McMinnville, OR  
Physical Review, Vol. 91, No. 5, pp 1043-1054 (1973)  
It is known that electrical breakdown between metal electrodes can be initiated by field emission. The present work concerns a further study of that initiation process under conditions of excellent vacuum and a clean cathode surface. As the field current density from the single crystal tungsten emitter is continuously increased, the normal emission is terminated by an explosive vacuum arc. Since this breakdown occurs in less than a microsecond, the experimental observations were obtained by use of pulse electronic techniques. The magnitude of the electric field, current density, and work function at the cathode were simultaneously determined prior to breakdown. From this investigation it has been established that: (1) the vacuum arc was initiated at a critical value of the field current density of the order of 10<sup>5</sup> amperes/cm<sup>2</sup>; (2) breakdown was predictable and not random; in fact easily recognizable conditions preceding arc formation have been established; at current densities just below the critical value, an electron emission process was observed, which apparently involved both high electric fields and high temperatures; (3) arc formation did not require cathode bombardment by material from the anode or from residual gases; (4) breakdown was independent of the applied microsecond voltage in the range 5 kV-60 kV, provided the critical current density was not exceeded; (5) the current during arc exceeded the initiating field current by a factor of at least 10<sup>3</sup>. 32 Refs.  
Primary Keywords: Field Emission; Tungsten Cathode; Critical Current Density; High E-field; High Temperature; Voltage vs Pulse Duration  
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2026  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Gas, Electrical; Gas Gaps; Optical)  
MEASUREMENT OF THE ACTUATION TIME OF SPARK GAPS IN A CASCADE PULSE-VOLTAGE GENERATOR  
J.R. Parker  
Karkov Polytechnic Institute  
Instruments And Experimental Techniques, No. 1 pp 128-131 (01/1974)  
Trans. From: Priroda i Tekhnika Eksperimenta 1, 117-120 (January-February 1974)  
The methods and results are described of measuring the actuation time of the spark gaps in a seven-stage high-voltage pulse generator. The results were obtained by photography using an SFR streak camera. The integral probability curves which were obtained provide a quantitative estimate of the effect of the mutual illumination between spark gaps on the actuation time. 5 Refs.  
Primary Keywords: Spark Gap; Breakdown Time; Ultraviolet Radiation; Gap Communication; Relation To Overvoltage  
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2030  
(PULSE GENERATORS)  
(Capacitive)  
PULSE GENERATOR FOR A THIN-ECHO NUCLEAR MAGNETIC RESONANCE RELAXOMETER  
V.M. Zagladov, A.M. Zharkov, V.S. Matochkin and M.I. Emel'yanov  
Instruments And Experimental Techniques, Vol. 16, No. 8, pp 1842-1844  
(12/1973)  
Trans. From: Priroda i Tekhnika Eksperimenta 6, 192-194 (November-December 1973)  
The circuit of a rectangular pulse generator designed for modulation of the spin-echo transmitter of a nuclear magnetic resonance (NMR) relaxometer in measurements of the relaxation times in the laboratory and rotating coordinate systems is described. The use of the generator considerably shortens the process of resetting the equipment for measurements performed in different coordinate systems. 6 Refs.  
Primary Keywords: Pulse Generator; Delay Line; Pulse Shaper; Several Outputs  
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2036  
(PULSE GENERATORS)  
(Miscellaneous)  
SIMPLE INSTRUMENTATION FOR RISE AND DECAY TIME MEASUREMENT OF CATHODOLUMINESCENCE IN AN ELECTRON MICROSCOPE  
J. Lebedev, L. White and R. Bialla  
Pennsylvania State University, University Park, PA  
The Review Of Scientific Instruments, Vol. 45, No. 3, pp 451-452  
(1974)  
A pulsed voltage generator has been built for an electron microscope for measuring rise and decay characteristics of cathodoluminescence from micron size sample areas. The pulsed voltage generator has an advantage in that excessive heating of the sample can be avoided by keeping the electron beam on the sample surface only for the duration necessary to get the full trace. Both the pulsing frequency and the pulse duration are variable continuously over wide ranges. 6 Refs.  
Primary Keywords: Electron Microscope; Cathodoluminescence; Variable Pulse Frequency; Variable Pulse Duration  
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2041  
(PULSE GENERATORS)  
(Miscellaneous)  
TUNNEL DIODE NARROW PULSE GENERATOR  
Z. Tan  
University of Auckland, Auckland, New Zealand  
Proceedings Of The IEEE, (November 1973), pp 1659-1660 (11/1973)  
A simple tunnel diode circuit is described which can generate narrow current pulses from 100-amplitude voltage pulses at instances in time corresponding to either the leading or the trailing edge of the driving pulses. The pulse generator is capable of producing pulses at a rate of about 330 MHz. 2 Refs.  
Primary Keywords: Displaced Nonlinear Load Line; Tunnel Diode  
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2042  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Physics)  
ULTRASHORT PULSE MEASUREMENTS  
D. Bradley and G. New  
Imperial College, University of London, London, UK  
Proceedings Of The IEEE, Vol. 62, No. 3, pp 313-345 (03/1974).  
247 Refs.  
Primary Keywords: Ultrashort Light Pulse Measurements; Electrooptical Streak Camera; Two-photon Fluorescence Method; Direct Measurements Of I(t); photodiodes; chirping; pulse compression; dynamic spectroscopy  
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2050  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
FORMATIVE TIME OF PENNING DISCHARGE  
S.I. Ivanov  
Sofia University, Bulgaria  
International Journal Of Electronics, Vol. 34, No. 6, pp 769-775  
(06/1973)  
This paper describes an investigation done into the formative time of a Penning discharge and into the effect of variations in anode voltage, pressure, and magnetic field upon this time. The formative time was found to be on the order of hundreds of microseconds and decreased if any of the three varying parameters was increased. This long formative time (as compared to the formative time of a glow discharge) can be explained in terms of the decrease in the cross-field mobility of the electrons. 5 Refs.  
Primary Keywords: Penning Discharge; Control Grid; Quench Pulse; Formative Time; Experiment; Theory  
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2051  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
GAS BREAKDOWN BY A SHORT LASER PULSE  
C.E.M. Ireland and C.G. Morgan  
University College of Swansea, Singleton Park, Swansea, Wales  
Journal Of Physics D: Applied Physics, Vol. 6, No. 6, pp 720-729  
(06/1973)  
The breakdown of gases by short (typically sub-nanosecond) laser pulses, with the two dominant mechanisms governing the plasma growth and multi-photon and cascade ionization is treated theoretically. It is shown that two important pressure regimes result: a low pressure regime where the breakdown is governed solely by the multiphoton ionization process, and a high-pressure regime where the expression for threshold breakdown intensity involves both ionization processes as well as the effect of inelasticities in the gas. The predictions of the theory are compared with published experimental data for ruby and Nd:YAG laser pulses. Good agreement is obtained in the case of ruby radiation, and a possible explanation of deviation from the experimental data obtained using a Nd:YAG laser is offered. 17 Refs.  
Primary Keywords: Sub-nanosecond Laser Pulse; Multiphoton Plasma Growth; Cascade Ionization; Low Pressure; High Pressure; Nd:YAG Laser; Ruby Laser  
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2055  
(PROBING STORAGE, CAPACITIVE)  
(Capacitors)  
SINGLE TIME MEASUREMENT DETERMINES CAPACITOR R AND L  
C. Vaidya  
Massachusetts Institute of Technology, Cambridge, MA  
Electronics, Vol. 45, No. 21, pp 119-120 (10/1972)  
The resistance and inductance of a capacitor is easily measured using a pulse generator and an oscilloscope. The DC offset of the capacitor voltage response is used to calculate the resistance while the overshoot transient is used to calculate the inductance. 0 Refs.  
Primary Keywords: Capacitor Characterization; Dissipation Factor; Inductance Measurement  
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2082  
(PULSE GENERATORS; BREAKDOWN STUDIES)  
(Electrodes; Vacuum; Electrical)  
THE NATURE OF FIELD EMISSION SITES

B. M. Cox  
Marchand Engineering Lab., Southampton, UK  
Journal Of Physics D: Applied Physics, Vol. 8, No. 17, pp 2065-2073  
(12/1975).

A probe-hole technique for measuring and mapping electron emission from metal surfaces (e.g. contacts from used vacuum switches) has been developed for use in situ in a scanning electron microscope. A single emitting region can be selected and its voltage/current characteristics measured. The specific site of the emission source can be predicted, to an accuracy of better than  $\pm 10$  microns, using an electron beam tracking technique; then this site can be examined with the microscope. Visual evidence is shown of 'conditioning' an electrode by voltage breakdown. The link between the source of pre-breakdown current and the site of a spark is confirmed in an experiment which demonstrates the accuracy of predicting the position of emission sites. The ambiguity of the Fowler-Nordheim method of analysing voltage/current characteristics is shown by the failure to correlate size predictions with visual observation of certain types of emitter. 20 Refs.

Primary Keywords: Field Emission; Scanning Electron Microscope; Emission Site Location; Emission Site Prediction; Electrode Conditioning  
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2085  
(ENERGY STORAGE; MECHANICAL)  
(Rotating Machinery; Materials)  
THE TESTING OF SLIDING ELECTRICAL CONTACTS FOR HOMOPOLAR GENERATORS  
M. Brennan, Z. Eliazar, W.F. Weldon, H.G. Rylander and H.M. Woodson  
University of Texas at Austin, Austin, TX 78712  
IEEE Transactions On Components, Hybrids, And Manufacturing Technology, Vol. CHMT-2, No. 1, pp 111-115 (03/1979).

Due to the recent interest in homopolar generators as pulsed power supplies, the need has arisen for pulsed brush data on slip rings at high current levels and high surface velocities. Tests were conducted to examine the effect of varying the apparent area of contact on the coefficient of friction, voltage drop, and wear rate. Brush areas from 0.808-3.23 sq cm were individually tested at current levels from 0.0-2800 A per brush. Experimental data are presented for a high copper grade of commercially available sintered copper-graphite material. The data corroborate the 'thermal mounding' phenomenon described by R.A. Marshall. 8 Refs.

Primary Keywords: Arcs; Voltage Drop Measurement; Wear Rate Measurement  
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2090  
(PULSE GENERATORS)  
(Capacitive)  
HIGH-VOLTAGE PULSE GENERATOR  
L. Z. Barabash, D.I. Krivzhankovskii and P.I. Lobedev  
Institute Of Theoretical And Experimental Physics, Moscow, USSR  
Instruments And Experimental Techniques, No. 1, pp 133-134 (02/1970).  
Trans. From: Priroda i Tekhnika Eksperimenta 1, 121-123  
(January-February 1970).

A generator of high-voltage pulses for feeding the inflector of an input system, operating on ion beams into the chamber of the JEP proton synchronon is described. The generator forms symmetrical different polarity pulses the amplitude of which is adjusted from  $\pm 5$  to  $\pm 25$  kV; the time of establishing the voltage on the inflector is 150 microseconds, and the interruption time is  $\leq 0.1$  microsecond. 3 Refs.

Primary Keywords: Pulse Generator; Thyristor; Capacitive Load; 25 kV Output; Bipolar Pulse; Symmetric Pulse  
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2094  
(PULSE GENERATORS)  
(Capacitive)  
NANOSECOND-PULSE GENERATOR USING THYRISTORS  
I.I. Rozhkov  
Gorkii Polytechnic Institute, USSR

Instruments And Experimental Techniques, Vol. 14, No. 4, pp 1083-1084  
(08/1971).  
Trans. From: Priroda i Tekhnika Eksperimenta 4, 119-120 (July-August 1971).

The paper describes a thyristor circuit for matching the channel in a nanosecond-pulse generator for waves reflected from an unmatched load. The shaping of the pulses of the generator is based on using electromagnetic shock waves in transmission lines containing ferrite. Experimental samples of a nanosecond-pulse generator having a rated power of 363 W with a repetition frequency of up to 10 kHz were created. 4 Refs.

Primary Keywords: Pulse Generator; Electromagnetic Shock Wave; Ferrite Loaded Peaking Line; Unmatched Storage Capacitor; No Reflections; Thyristor; Thyristor  
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2100  
(PULSE GENERATORS; PULSE GENERATORS)  
(Systems; Capacitive)  
PULSED SUPPLY OF PHOTOMULTIPLIERS  
I. V. Savin, M.G. Ivenenko, G.N. Markov and S.V. Sanylov  
Instruments And Experimental Techniques, No. 1, pp 185-187 (02/1970).  
Trans. From: Priroda i Tekhnika Eksperimenta 1, 163-164  
(January-February 1970).

The operation of an FEU-30 photomultiplier on feeding with a pulsed voltage of up to 15 kV with a pulse length of 3 microseconds was studied. The leading edge of a single electron pulse was shortened to 1.5 nsec. The circuit of the pulse generator and effects accompanying the pulsed feeding of the photomultiplier are considered. 5 Refs.

Primary Keywords: Pulse Generator; Thyristor; 10 kV Output; 10 A Output; 5-Microsecond Pulse Width  
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2107  
(PULSE GENERATORS; PULSE GENERATORS)  
(Systems; Capacitive)  
SPARK-CHAMBER POWER-SUPPLY CIRCUIT WITH SEMICONDUCTOR TRIGGER

A.F. Iyudin, A.V. Kurochkin, E.M. Shernamzon and Yu.T. Yurkin  
Moscow Engineering Physics Institute, Moscow, USSR  
Instruments And Experimental Techniques, No. 4, pp 1058-1059 (08/1970).  
Trans. From: Priroda i Tekhnika Eksperimenta 4, 90-91 (July-August 1970).

The circuit of a spark-chamber power supply which utilizes transistors operating in the avalanche mode, dynistors, and a vacuum spark relay is presented. The operational threshold is less than 100 mV. The delay of the high voltage pulse with respect to the input pulse is approximately 80 nsec. 4 Refs.

Primary Keywords: Pulse Generator; Transistor Driver Circuit; Vacuum Spark Gap; Low Delay; Low Jitter; Low Trigger Voltage  
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2109  
(PULSE GENERATORS; SWITCHES; CLOSING)  
(Trigger; Thyristors)  
THYRISTOR HIGH-VOLTAGE PULSE GENERATORS

V.A. Anterimov, N.G. Voronova and V.M. Knyazev  
Instruments And Experimental Techniques, No. 3, pp 817-818 (04/1970).  
Trans. From: Priroda i Tekhnika Eksperimenta 3, 162-163 (May-June 1970).  
Thyristor high-voltage pulse generators for triggering spark chambers are described. The generators use K201C thyristors and produce isolated pulses having for the respective generators the following parameters: pulse voltage, 4 and 5 kV; pulse current, 100 and 50 A; rise time, 100 nsec; duty from moment of application of triggering pulse, 20 and 40 nsec. 3 Refs.

Primary Keywords: Trigger Pulse Generator; Thyristor; Pulse Transformer; Capacitor Generator  
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2110  
(PULSE GENERATORS; BREAKDOWN STUDIES)  
(Capacitive; Exploding Wire)  
THYRISTOR PULSE CIRCUIT FOR CONTROLLING THE EXPLOSION OF A THIN WIRE  
Ya. S. Broun and F.I. Slesinger  
Transcaucasian Branch, ENIMS, Eravan  
Instruments And Experimental Techniques, No. 1, pp 139-140 (02/1970).  
Trans. From: Priroda i Tekhnika Eksperimenta 1, 126-127  
(January-February 1970).

A circuit for control of wire explosion in a magnetic field is described. The wire itself closes the circuit, being driven by a current pulse shaped by an LC circuit containing the wire. 2 Refs.

Primary Keywords: Pulse Generator; Low Voltage; Low Current; Thyristor; Exploding Wire; Self-switching; Wire Displacement; I x S Force  
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2111  
(BREAKDOWN STUDIES)  
(Vacuum; Electrical)  
TIME CHARACTERISTICS OF ELECTRICAL BREAKDOWN IN VACUUM  
N.F. Olendzky and M.A. Sal'man  
Soviet Physics-Technical Physics, Vol. 15, No. 2, pp 242-247 (08/1970).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 40, 335-339 (February 1970).

Two-second characteristics of breakdown in vacuum up to 550 kV have been determined with interelectrode gaps in the range of 5-15 mm with unconditioned electrodes. The breakdown delay time is calculated from the volt-second characteristics with ramp voltage pulses. It was found that with unconditioned electrodes the pulse factor (surge factor) and delay time increase when the interelectrode gap is increased. 7 Refs.

Primary Keywords: Temporal Resolution; Unconditioned Electrode; 5-15 mm Gap; Delay Measurement  
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2133  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Particle Beams; Neutral)  
SPECTRALLY RESOLVED OPTICAL DIAGNOSTICS FOR HIGH-POWER NEUTRAL BEAMS  
J.F. Bonnaud, G. Bracco, C. Breton, C. DeMichelis, J. Druaux, M. Pottol, R. Oerson and J. Romette  
EURATOM-CEA, Centre d'Etudes Nucleaires, France 92260  
Physics Letters, Vol. 75A, No. 1-2, pp 65-68 (12/1979).

An optical method of diagnosing a high-power neutral beam is proposed. Spectral profiles for some of the neutral particle emissions are obtained and then used to calculate the proportions of the different populations. An a posteriori check of the results is also done. 7 Refs.

Primary Keywords: Neutral Beam; Target Interactions; Emitted Light; Forward Emission; Beam Energy; Particle Flux  
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2139  
(POWER CONDITIONING)  
(Pulse Transformers)  
DESIGN OF TESLA TRANSFORMERS USED IN DIRECT-VOLTAGE ACCELERATORS

D. Kh. Dinev  
University of Sofia, Bulgaria  
Soviet Atomic Energy, Vol. 46, No. 3, pp 208-209 (03/1979).  
Trans. From: Atomnaya Energiya 46, 179-180 (March 1979).

Direct-voltage charged-particle accelerators, employing the Tesla transformer as a high-voltage generator, have come into wide use in recent years. In such accelerators the load to the secondary transformer circuit is the accelerating tube which accelerates beams with pulse currents ranging from tens to several thousands amperes. The present paper considers theoretically the effect of this load on the processes in the Tesla transformer and on its parameters. 2 Refs.

Primary Keywords: Tesla Transformer; Analysis; Coupling Coefficient; Load Considerations  
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2147  
(SWITCHES, CLOSING; SWITCHES, OPENING)  
(Vacuum Gaps, Electrical; Vacuum Gaps, Magnetic Field)  
MAGNETICALLY CONTROLLED VACUUM-ARC ON-OFF SWITCH  
R. Dathlefsen and J. Mylius  
Gould Inc., Colmar, PA 18915  
IEEE Transactions On Electron Devices, Vol. ED-26, No. 10 pp 1491-1496  
(10/1979)  
A vacuum spark gap is demonstrated which attains high-power switch-off capability by a magnetic control field applied to the anode in a Penning-type discharge geometry. Applying the magnetic field raises the arc voltage and excites oscillations. Circuit interruption results if the arc current is reduced to the current chopping level of the cathode material. Shunt capacitance raises the interruption ability. Currents up to 9 kA were interrupted. Transient recovery voltages ranged up to 20 kV. 10 Refs.  
Primary Keywords: Vacuum Arc; Pulsed Magnetic Field; Cathode Current  
Chopping Level; Penning Discharge  
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2156  
(POWER CONDITIONING)  
(Pulse Forming Networks)  
PULSE-FORMING NETWORKS WITH TIME-VARYING OR NONLINEAR RESISTIVE LOADS  
R.M. Roark, M.E. Porten, L.B. Masten and T.R. Burkes  
Texas Tech University, Lubbock, TX 79409  
IEEE Transactions On Electron Devices, Vol. ED-26, No. 10 pp 1541-1544  
(10/1979)  
High-power pulse-forming networks (PFN) have been in use for some time. The networks are usually designed using techniques that assume a desired pulse shape and a constant resistive load. High-power gaseous discharge devices have created a need for high-power pulse generation operating into time-varying resistive loads or nonlinear resistive loads. Although some work has been done in designing a PFN with a time-varying load, little has been done for the nonlinear loads in general. In this paper a study of the effects of a time-varying or nonlinear load on a PFN is presented using simulation techniques. The resultant output pulse is compared to the desired pulse using different error functions, such as mean-square error and absolute error. The sensitivity of the error function with respect to the parameters of the PFN is determined. A criterion is developed for the adjustment of the parameters of a PFN to improve the pulse delivered to a time-varying or nonlinear resistive load. The form of the desired pulse, the error function, and the type of resistive load can be varied to obtain a specific adjustment criterion. In one case, applying the technique to a given PFN resulted in a 46.4-percent improvement in mean-square error. 5 Refs.  
Primary Keywords: Nonlinear Load; Numerical Calculation; Design Considerations; Comparison With Experiment  
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2161  
(ENERGY STORAGE, INDUCTIVE; PARTICLE BEAMS, ELECTRON)  
(Systems, Generation)  
ANALYSIS OF AN INDUCTIVE ENERGY HIGH-PERVEANCE ELECTRON-BEAM GENERATOR  
M. Weiner  
ECOM, Fort Monmouth, NJ 07703  
IEEE Transactions On Electron Devices, Vol. ED-26, No. 10 pp 1531-1536  
(10/1979)  
Recently, Slivkov and Dolgachev proposed an interesting type of electron-beam generator, consisting of a high-voltage triode in series with a storage inductor. During the storage time, the triode operates with a depressed collector voltage. A high-energy current pulse is obtained when the triode is switched from a high-perveance state to a low-perveance one. In this paper, the circuit model for the beam generator was expanded to take into account grid capacitance and beam loss. Computer results based on the new circuit model predict a train of sinusoidal-like pulses in the triode output when the grid is suddenly connected to a portion of the storage inductor. An electron-beam generator, capable of producing a train of megavolt pulses at high currents, is predicted. 4 Refs.  
Primary Keywords: Storage Inductor; High Voltage Triode; Low Perveance; Modelling; Numerical Calculation  
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2164  
(POWER CONDITIONING)  
(Pulse Forming Networks)  
A MODULAR PFN WITH PULSEWIDTH ADJUSTMENT  
W.J. Blinichikoff and R.A. Gardner  
Westinghouse Electric Corp., Baltimore, MD 21203  
IEEE Transactions On Electron Devices, Vol. ED-26, No. 10 pp 1537-1540  
(10/1979)  
This paper describes the design, analysis, and realization of a lightweight, low-impedance pulse-forming network (PFN) in which identical inductor-capacitor modules can be added or removed to change pulsewidth while maintaining high pulse quality without introducing excessive pulse-to-pulse perturbations. The PFN evolved contains an input module that is an optimizer for a pulse-plateau ripple of  $\pm 0.5$  percent. The ripple remains within this limit as modules are added or removed from the PFN to change the pulsewidth in 2-microsecond steps. The optimized parameters are presented in normalized form allowing the optimum response to be achieved for arbitrary pulsewidths and network impedances. This low-ripple response is achieved without incorporating mutual inductance into the design. Therefore, easing the module turning and assembly. Mutual inductance has been considered indispensable in PFNs, but it is a roadblock for modular construction. Its elimination as a design parameter is the key to realizing the modular PFN. A breadboard was built and tested under high power. Included are measured responses that verify that the modular concept and optimum response can be realized in practice. 2 Refs.  
Primary Keywords: Variable Pulse Width; High Pulse Quality; Low Impedance; Modular Design  
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2165  
(ENERGY CONVERSION, ELECTRICAL; ENERGY CONVERSION, ELECTRICAL)  
(Power Supplies; Charging Circuits)  
A NEW RESONANCE TRANSFORMER  
J.L. Harrison  
Maxwell Labs Inc., San Diego, CA 92123  
IEEE Transactions On Electron Devices, Vol. ED-26, No. 10 pp 1545-1549  
(10/1979)  
Resonance systems have been used to provide transformer-like voltage stepup from a low voltage to a high voltage. However, all early systems have the disadvantage that the voltage gain is limited to the Q of the total circuit (including the load). This imposes a severe gain limit and leads to high line voltage regulation under changing load conditions when the gain is moderate. The circuit described here is a new circuit which overcomes most of these early problems. It provides a gain which is relatively insensitive to the load circuit and is mainly limited to the product of the Q of the resonant loops (i.e., the regulation of the circuit is similar to that of an iron-core transformer). Furthermore, several stages can be stop or series connected to provide an unlimited potential gain. The circuit is thus a competitor of the iron-core transformer, and will be particularly attractive in very-high-voltage or high-frequency circuits where adequate insulation or hysteresis loss becomes a problem. 1 Refs.  
Primary Keywords: Resonance Transformer; Good Voltage Regulation; Resonant Q; High Gain; Series-parallel Connection  
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2169  
(POWER CONDITIONING)  
(Pulse Transformers)  
DESIGN OF COAXIAL-CABLE PULSE TRANSFORMERS  
R.E. Dollinger (1), D.A. Moll (1) and D.L. Smith (2)  
(1) State University of New York at Buffalo, Buffalo, NY 14226  
(2) AFWL, Kirtland AFB, NM 87117  
IEEE Transactions On Electron Devices, Vol. ED-26, No. 10 pp 1549-1551  
(10/1979)  
Coaxial-cable pulse transformers with good high-frequency response (30-ns rise time) and excellent high-voltage interwinding insulation ( $>300$  kV primary to secondary) were designed, built, and tested. They have the advantage that the open-circuit transformation ratio is unaffected by the thickness of the interwinding insulation, and good coupling is maintained with stepup designs. An equivalent circuit was developed, involving two coupling coefficients, which predicted the measured results with reasonable accuracy. Values of primary, secondary, and leakage inductances were 1.4, 2.2, and 0.8 microHenry, respectively. 9 Refs.  
Primary Keywords: Coaxial-cable Pulse Transformer; Fast Rise Time; High Voltage Capability; Very Good Coupling; Voltage Stepup  
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2172  
(SWITCHES, CLOSING)  
(Thyratrons)  
DOUBLE-ENDED HYDROGEN THYRATRONS FOR CROWBAR PROTECTION OF HIGH-POWER TWT SYSTEMS  
N.S. Nicholls (1), H. Manoun (2) and R.J. Wheldon (2)  
(1) Royal Radar Establishment, Malvern, Worcestershire, UK  
(2) English Electric Valve Co Ltd, Chelmsford, Essex, UK  
IEEE Transactions On Electron Devices, Vol. ED-26, No. 10 pp 1456-1461  
(10/1979)  
The paper describes a new range of compact double-ended thyratrons specifically designed for crowbar use up to 100 kV with an auxiliary power consumption of only 75 W. A dynamic test arrangement is described which demonstrates the tube's capability of discharging 0.75 microfarad charged to 60 kV, the current rising to 500 A at a rate of 50 kA/microsecond, with an anode delay time of 200 ns. The test equipment simulates either grounded cathode or floating deck operation under conditions where a flash arc fault occurs. The efficacy of the protection is evaluated by monitoring the 'let-through current', charge, and energy. Coincidence counters register faulty operations. A compact auxiliary supply module makes these tubes especially attractive to aerospace systems engineers. 4 Refs.  
Primary Keywords: Ceramic Thyratron; Multigap; Crowbar; 'Thyratron' Mode; H.T. Transient Analysis; Fault Simulation  
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2175  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
HIGH REPEATITION RATE BURST-MODE SPARK GAP  
A. Fallens, L.L. Pagnato, R. Hester, A. Chesterman, E.G. Cook, T. Yokota and W. Dexter  
Lawrence Livermore Lab, Livermore, CA 94550  
IEEE Transactions On Electron Devices, Vol. ED-26, No. 10 pp 1411-1413  
(10/1979)  
Results are presented on the design and testing of a pressurized gas blown spark-gap switch capable of high repetition rates in a burst mode of operation. The switch parameters which have been achieved are as follows: 220 kV, 42 kA, a five-pulse burst at 1 kHz, 10-ns rise time, 2-ns jitter at a pulsewidth of 50 ns. 1 Refs.  
Primary Keywords: Gas Blown Spark Gap; Burst-Mode; High Reliability  
Secondary Keywords: Blunkin  
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2176  
(PARTICLE BEAMS, ELECTRON; PARTICLE BEAMS, ION)  
(Generation, Generation)  
HIGH-POWER ELECTRON AND ION BEAM GENERATION  
J.A. Nation  
Cornell University, Ithaca, NY 14850  
IEEE Transactions On Electron Devices, Vol. ED-26, No. 10 pp 1501-1503 (10/1979)  
The author presents a review of high-power electron and ion beam generation. A general overview is given for Marx generators, pulse forming networks, insulators (including a presentation of some unpublished data on dielectric strengths and breakdown times), and beam diodes. The mechanisms involved in the generation of electron and/or ions are examined. Also presented are discussions of inductive accelerators and collective ion acceleration. 154 Refs.  
Primary Keywords: Review; Beam Description; Machine Description; Basic Physics Of Generation; Marx Generator  
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2178

(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)

## MULTICHANNEL SURFACE SPARK GAPS

W.J. Sarjeant, R.S. Taylor, A.J. Alcock and K.E. Leopold  
National Research Council, Ottawa, Ontario, Canada  
IEEE Transactions On Electron Devices, Vol. ED-26, No. 10 pp 1414-1417  
(10/1979)

A study has been undertaken on high-pressure surface discharge switches potentially capable of moderate repetition rate operation. The parametric experiments reported were carried out utilizing the gaps as transfer switches, under pulse charging conditions, between several types of low-impedance transmission lines and a high-pressure xenon gas halide laser discharge, acting as the load. The effects of spark gap internal geometry, gas composition, and controlled changes in the laser load, upon gap multichanneling, closure simultaneity, and peak holdoff capability are discussed. These surface gaps, of length 64 cm, reliably close 19 channels per side (29 per meter) with a holdoff voltage greater than 120 kV and a closure simultaneity of approximately 2 ns for the first 500 shots, increasing to about 5 ns and remaining there for 10000 shots, the test limit to date. Preliminary results at higher charging voltages have yielded intense multichanneling with holdoff voltages in excess of 210 kV. 8 Refs.

Primary Keywords: Surface Discharge; Rep-rated; Geometric Effects; Intense Multichanneling

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2180

(SWITCHES, CLOSING)  
(Gas Gaps, Crossed-field)

## OPERATING CHARACTERISTICS OF THE CROSSED-FIELD CLOSING SWITCH

R.J. Harvey  
Hughes Research Labs, Malibu, CA 90265  
IEEE Transactions On Electron Devices, Vol. ED-26, No. 10 pp 1472-1482  
(10/1979)

The function of the crossed-field closing switch (CFCFS) has been studied over a wide range of variables. Three different modes of conduction have been observed: the conventional crossed-field discharge, a hybrid hollow-cathode discharge, and the vacuum arc. Depending on the amplitude and duration of the current, conduction may typically pass through these modes in the above sequence. The CFCFS may be triggered magnetically or by grid control into a number of states with varying levels of voltage drop. Conduction may be allowed in the reverse direction or prevented. The present design is limited in response speed and repetition rate by the inductance of the grid and anode leads, the lack of efficient pressure control, and the need for a pulsed magnetic field. Criteria are presented which show the directions in which extrapolations in design may lead. It is concluded that the CFCFS is potentially capable of performing some functions more reliably or effectively than conventional switching devices, and variants of the device may eventually be capable of performing functions not presently achievable by any other means. 13 Refs.

Primary Keywords: Closing Switch; Three Conduction Modes; Magnetic Trigger; Grid Trigger; Helium Filled; Rep-rated

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2186

(SWITCHES, CLOSING)  
(Gas Gaps, Self)

## TIME-RESOLVED RESISTANCE DURING SPARK GAP BREAKDOWN

W.K. Cary Jr. and J.A. Mazzie  
Naval Surface Weapons Center, Dahlgren, VA 22448  
IEEE Transactions On Electron Devices, Vol. ED-26, No. 10 pp 1422-1427  
(10/1979)

The breakdown voltage and the time derivative of the current through a spark gap terminating a transmission line were measured as a function of 4 gas species, 3 gap pressures, and 2 gap spacings. From these measurements, the time-varying channel resistance, the power, and the energy dissipated in the discharge can be determined for the first 1500 ps of breakdown. Data were obtained with a 74-cm-long transmission line, open at the charging end, and terminated by a spark gap at the other end. The line was pulse charged with a 2-microsecond rise time pulse having a maximum voltage of 3 kV. The breakdown voltage was determined by monitoring the charge voltage waveform while a di/dt probe close to the spark gap provided a sampling oscilloscope with the other desired signal. The latter waveform was then digitized and the data were reconstructed using Fourier techniques on a computer to account for the frequency response of the required signal delay line. 4 Refs.

Primary Keywords: Breakdown Voltage; di/dt Measurement; Derived Resistance; Pulse Forming Line

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2188

(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)

## DEVELOPMENT OF A 100-KV MULTIMEGAWATT REPETITION RATE GAS SWITCH

A. Ramrus  
Maxwell Laboratories Inc., San Diego, CA 92123  
IEEE Transactions On Electron Devices, Vol. ED-26, No. 10, pp 1417-1421 (10/1979)

A 100 kV gas switch has been developed and tested which is capable of controlling 5 MW average power when operated up to 250 pps repetition rate. Recovery of the switch voltage holdoff capability after each discharge was accomplished by providing both a 1 ms grace period during which no voltage is reapplied and by continuously purging the switch with 40 psig pressurized air at flow rates up to 60 SCFM. The switch was tested using a simulation technique in which the switch was subjected to the same repetitive peak voltage and current as it would in controlling several megawatts of average power. Limits of switch performance as a function of air flow rate and peak voltage have been established. 0 Refs.

Primary Keywords: Controls; 5 MW Average Power; 250 Pps Repetition Rate; Pressurized Air Flow; Simulation Testing; Matched Load PSN

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2189

(BREAKDOWN STUDIES)  
(Gas, Electrical)

## ELECTRICAL BREAKDOWN OF GASES: IONIZATION GROWTH IN AIR AT HIGH PRESSURES

J. Dutton, F.L. Jones and R.W. Palmer  
University College of Swansea, Singleton Park, Swansea, Wales  
Proc. Phys. Soc., Vol. 78, No. 4, pp. 569-583 (02/1961)

This paper describes experiments used to measure the ionization coefficients in air extending the range of pd (pressure x distance) values examined up to 2300 Torr cm for which the sparking potential is about 80 kV. The value of E/p for the experiments was varied from 35 to 40 v/cm Torr. The growth of pre-breakdown ionization currents is analyzed using (1/i<sub>0</sub>, d) graphs, where 1/i<sub>0</sub> is the small initial current from the cathode. Initial results showed that the cathode surface had an effect on the value of the secondary ionization coefficient. Once these effects were negated by using a silver cathode it was found that the secondary ionization coefficient was dependent only on E/p, while the primary ionization coefficient showed a decrease as pressure was increased at a constant E/p. The results found agree fairly closely with previously published results even though the accuracy of the measurement of the ionization current had improved. 20 Refs.

Primary Keywords: Townsend's Second Ionization Coefficient; E/p Variation; Dry Air

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2190

(BREAKDOWN STUDIES)  
(Gas, Electrical)

## VARIATION OF TOWNSEND'S SECOND COEFFICIENT IN ELECTRODELESS DISCHARGE

San S.N. and Ghosh A.K.  
Jadavpur University, Calcutta, India  
Proc. Phys. Soc., Vol. 79, pp. 180-189 (06/1962)

The authors report the variation of Townsend's second coefficient in an electrodeless discharge. Results for several lengths and pressures in dry air are presented, along with the variation with E/p. A mathematical expression is presented for the variation of Townsend's second coefficient with E/p, which agrees well with experimental results. 8 Refs.

Primary Keywords: Townsend's Second Coefficient; Electrodeless Discharge; Pressure Variation; E/p Variation

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2191

(POWER CONDITIONING)  
(Pulse Transformers)

## PULSE TRANSFORMERS

H.W. Lord  
General Electric Co, Schenectady, NY 12301  
IEEE Transactions On Magnetics, Vol. MAG-7, No. 1, pp 17-28 (03/1971)

Pulse transformers capable of transmitting substantially rectangular voltage pulses, with durations of less than one microsecond, were developed for radar applications during World War II. Their primary functions were to match the impedances of high-power microwave radio-frequency electron-tube generators to electronic pulse generators and coaxial transmission cables, and to provide polarity reversal and impedance matching functions within pulse generator circuitry. The principle contributor to the development of satisfactory pulse transformers was the development of cores of thin-gauge magnetic materials having 1 microsecond pulse permeabilities in the range of 500 to 3500 for flux-density changes of 10000 G. The development of void free dry-type insulation systems made it possible to produce dry-type pulse transformers for operation at pulse voltages below 12 kV. The pulse transformer development work was paralleled by analytical work which enabled pulse transformer designers to make designs to meet the requirements of the radar circuit designers. The analysis relates the three principle pulse transformer parameters, which are magnetizing inductance, leakage inductance and effective distributed capacitance, in combination with the circuit parameters which are source resistance, effective load resistance, and load shunt capacitance, to the rise time, top ripple and droop, and fall time of the output pulse. 19 Refs.

Primary Keywords: Impedance Matching; Core Construction; History; Design Considerations

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2211

(SWITCHES, OPENING)  
(Gas Gaps, Crossed-field)

## A HIGH SPEED HVDC CIRCUIT BREAKER WITH CROSSED-FIELD INTERRUPTERS

G.A. Hifmann, G.L. LaBarbera, N.E. Reed and L.A. Shillong  
Hughes Research Labs, Malibu, CA 90265  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-95, No. 4, pp 1182-1192 (08/1976)

A novel HVDC circuit breaker is described which utilizes crossed-field interrupters in a sequential switching mode. The breaker and its components were tested in an inductive energy storage facility at levels of 1000 A, 100 kV and performed satisfactorily. 22 Refs.

Primary Keywords: 1000 A, 100 kV HVDC Circuit Breaker; Crossed-field Interrupters; Opening Switch

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2217

(SWITCHES, CLOSING)  
(Avalanche Transistors, Electrical)

## METHOD OF APPLYING AN AVALANCHE TRANSISTOR GENERATED 70 NS GATING IMPULSE TO A FOCUSED PHOTOMULTIPLIER

B.L. Elphick  
Atomic Weapons Research Establishment, Aldermaston, Berkshire, UK  
Journal Of Physics E: Scientific Instruments, Vol. 2, Series 2, pp 953-955 (02/1976)

Primary Keywords: Transformer Coupled; 70 Nanosecond Pulse Width; 10 Nanosecond Switching Time; Photomultiplier Driver

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2244

(PULSE GENERATORS; POWER CONDITIONING)  
(Systems, Pulse Transformers)

## 500 KV NANOSECOND SQUARE WAVE PULSE GENERATOR

G.A. Masvats, V.V. Knyazov and V.P. Osipov  
Tomsk Polytechnic Institute, Tomsk, USSR  
Instruments And Experimental Techniques, No. 2, pp 379-381 (04/1969)  
Trans. From: Prikl. i. Tekhnika Eksperimenta 2, 102-104 (March-April 1969)

This paper describes a pulse generator with the following output characteristics: pulse amplitude 500 kV; pulse duration, 10-40 nsec; pulse frequency, from single pulses to 50 Hz; pulse front duration, 3 nsec. The generator is designed to feed an electron tube. 6 Refs.

Primary Keywords: Marx Generator; Tesla Charging Transformer; Pulse Forming; Core Pulse Transformer

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2266  
(PARTICLE BEAMS, ELECTRON)  
(Transport)  
BEAM CHOPPER FOR SUBNANOSECOND PULSES IN SCANNING ELECTRON MICROSCOPY  
H.P. Feugebaum and J. Otto  
Siemens AG, München, FRG  
J. Phys. E: Sci. Instrum., Vol. 11 pp. 529-532 (07/1977).  
A method for deflecting the beam of primary electrons in a scanning electron microscope is described. Two trough-type travelling-wave structures are driven by two pulse generators of opposite polarity, thus creating the electrostatic field which deflects the beam. Primarily electron beam pulses of 350 ps are realized. 11 Refs.  
Primary Keywords: E-beam Chopper; Travelling Wave Structure; Fast Rise; Fast Fall  
Secondary Keywords: Scanning Electron Microscopy  
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2277  
(PULSE GENERATORS)  
(Trigger)  
A HIGH VOLTAGE PULSE GENERATOR FOR ACOUSTOELECTRIC STUDIES  
B. Griffing  
Purdue University, West Lafayette, IN 47907  
The Review Of Scientific Instruments, Vol. 45, No. 7, pp 964-965 (07/1974).  
A simple high voltage pulse generator, suitable for acoustoelectric studies, is described. Pulse outputs of variable width and amplitudes up to 1 kV are achieved. A technique to increase the maximum output to 3 kV is mentioned. 2 Refs.  
Primary Keywords: Capacitor Energy Store; Thyristor; Rectangular Pulse; 1 kV Operating Voltage  
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2281  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
A METHOD FOR DETERMINING DENSITY-RADIUS RELATIONS DURING WIRE EXPLOSIONS  
T. Kornhoff (1) and W. Chace (2)  
(1) Temple University, Philadelphia, PA 19122  
(2) Chace Assoc., Punta Gorda, FL 33950  
The Review Of Scientific Instruments, Vol. 42, No. 8, pp 1184-1186 (08/1971).  
A twin tube flash x-ray unit is used to probe the density of expanding metal vapor produced in exploding wire experiments. Using an axial orientation for one of the tubes, details seen in usual perpendicular pictures can be brought out. The developed x-ray film is scanned by a microphotometer and the trace compared with a standard wedge exposed on the same film. The tracings are then reduced to obtain density as a function of radius. Typical results as applied to copper wire are included. 4 Refs.  
Primary Keywords: Metal Vapor Density; X-ray Diagnostic; Axially Directed Radiation; Copper Wire  
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2283  
(SWITCHES, CLOSING; SWITCHES, OPENING)  
(Vacuum Gaps, Electrical; Vacuum Gaps, Self)  
RELAXATION PULSING WITH A VACUUM ARC DEVICE  
A.S. Gilmore Jr., R. Dollinger, C.M. Manikopoulos, P. Schwartz and M. Rosenfeld  
State University of New York at Buffalo, Buffalo, NY 14226  
1978 IEEE Thirteenth Modular Symposium, pp 217-221 (06/1978).  
In some configurations of a vacuum arc device with a cylindrical anode and an axially positioned cathode, high-repetition-rate relaxation pulsing occurs. Narrow, repetitive voltage spikes occur with amplitudes well in excess of several kilovolts. Each voltage pulse is accompanied by a rapid 'chop' in the current through the arc from a level as high as 10 kA to zero. The repetition rate for this phenomenon is approximately 30 kHz. Such a repetitive opening switch could be very useful if its pulse characteristics could be controlled. An intensive, experimental and diagnostic effort to understand this phenomenon has been in progress for some time now. This paper will present the results that have been obtained to date concerning the spiking phenomenon. 7 Refs.  
Primary Keywords: Switch Spiking; Self Relaxation; Self-magnetic Field; Plasma Burst  
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2284  
(SWITCHES, CLOSING; BREAKDOWN STUDIES)  
(Vacuum Gaps, Electrical; Vacuum, Electrical)  
BREAKDOWN MECHANISMS AND ELECTRICAL PROPERTIES OF TRIGGERED VACUUM GAPS  
G.R. Govinda Raju and F.A. Benson  
University of Sheffield, Sheffield, UK  
Journal Of Applied Physics, Vol. 47, No. 4 pp.1310-1317 (05/1975).  
Some electrical characteristics of a triggered vacuum gap (TVG) having three different dielectric materials have been studied. Silicon carbide which possesses very high resistance (500 M ohms), stannite ceramic of medium resistance (20 M ohms), and boron nitride of very low resistance (50 ohms) have been used. The resistance of the dielectric is found to decrease with increasing trigger current and this is attributed to the deposition of metal vapor on the surface. The minimum trigger voltage and trigger current necessary for a successful operation of the TVG are measured. Deconditioning (reduction) in the minimum trigger voltage, after repeated firings, has been found and is attributed also to the deposition of metal vapor on the dielectric surface. The minimum trigger current for successful firing of the main gap decreases with increasing trigger voltage. The probability of successful firing of the TVG is found to rise rapidly with increasing trigger voltage. The delay time between the application of the trigger pulse to the breakdown of the main gap decreases with increasing trigger current and trigger voltage. A mechanism is suggested for the operation of the TVG. 11 Refs.  
Primary Keywords: Triggered Vacuum Gap; Insulation Effects; Electrode Effects; Resistance Variation; Gap Statistics  
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2303  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
A RELIABLE MULTIMEGAVOLT VOLTAGE DIVIDER  
D.G. Pellinen and I. Smith  
Physics International Co., San Leandro, CA 94577  
The Review Of Scientific Instruments, Vol. 43, No. 2, pp 299-301 (02/1972).  
A two stage, DC coupled, linear resistive voltage divider having a rise time of 1.5 nsec has been used to measure voltage pulses up to 1.8 MV on a pulsed electron accelerator. The monitor has proved to be stable, reliable, and has required little maintenance. 5 Refs.  
Primary Keywords: Resistive Divider; Two Stage Divider; Copper Sulphate Resistor; 50 Ohm Output  
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2321  
(SWITCHES, OPENING; REVIEWS AND CONFERENCES)  
(Mechanical; Conferences)  
CURRENT INTERRUPTION IN HIGH-VOLTAGE NETWORKS  
K. Regaller Ed.  
Brown, Boveri & Co Ltd, Baden, Switzerland  
Publisher: Plenum Press, New York and London (01/1978).  
This conference record is primarily concerned with gas blast interrupters. The interaction of these breakers with the interruption of a power line fault is reported extensively. Two main interruption schemes: the thermal interruption mode, and the dielectric interruption mode are studied both theoretically and experimentally. DC current interruption is not considered. 273 Refs.  
Primary Keywords: Opening Switch; Gas Blast Interrupter; AC Current Interruption; Thermal Interruption Mode; Dielectric Interruption Mode; Experiment; Theory  
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2350  
(INSULATION, MATERIAL; POWER TRANSMISSION)  
(Solid; Cables)  
CORRELATION OF ELECTROCHEMICAL TREERING IN POWER CABLES REMOVED FROM SERVICE AND IN CABLES TESTED IN THE LABORATORY  
M.A. Martin Jr. and R.A. Martlein  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-99, No. 4, pp 1597-1605 (08/1980).  
Laboratory tests were performed to develop a relationship between treeing in extruded dielectric crosslinked polyethylene power cables removed from field service and cables tested in the Georgia Power Company Research Laboratory. New and used cables were subjected to various tests including accelerated treeing, thermal aging and chemical analyses. Cable integrity was examined by physical and optical examination, dissipation factor measurements, partial discharge measurements and AC high voltage breakdown testing. The information gathered during the project aided in the development of accelerated treeing tests to better evaluate the relative resistance of cables to electrochemical treeing and to determine effective cable life. 11 Refs.  
Primary Keywords: Cable Insulation; Crosslinked Polyethylene; Insulation Treeing; Cable Life  
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2360  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
DESIGN AND STRUCTURE OF AN EXTENDED LIFE HIGH CURRENT SPARKGAP  
Affinito, D., E. Bar-Avraham and A. Fisher  
Univ of California, Irvine, CA  
IEEE Transactions On Plasma Science, Vol. PS-7, No. 3, pp 162-163 (05/1979).  
The failure modes of a high-current 100-kA 0.6-C sparkgap were studied. The results of the study were used to design and build a high reliability, high-current sparkgap (130-kA 0.7-C). The structure of the sparkgap and the results of the testing are described. 7 Refs.  
Primary Keywords: Failure Modes; Repetitive Pulse Applications; Electrode Erosion; Field Enhancement; Insulator Tracking; Design  
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2382  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
A TECHNIQUE FOR MEASURING NONSQUARE PULSED HIGH VOLTAGES TO  $\pm 0.25\%$  ACCURACY  
J.W. Holm-Kennedy and T.P.C. Ku  
University of California, Los Angeles, CA 90024  
The Review Of Scientific Instruments, Vol. 43, No. 1, pp 31-37 (01/1972).  
An accurate technique ( $\pm$  for- 1/4% error) for measuring a wide range of pulsed voltages and currents of large magnitude (kilovolts and amperes) and short duration at either low or high repetition rates is described. The technique is accurate for both square and nonsquare pulses. The technique is particularly useful for measuring the J-E characteristics (current density-electric field) of semiconductor devices at high electric fields. The unknown voltages are matched on a CRD to voltage-divided Zener diode limited pulses which are accurately known. The sample circuit and reference pulse circuits are given. The accuracy of the technique is demonstrated over a wide voltage and current range. Operating and construction precautions are listed for the convenience of the reader. 8 Refs.  
Primary Keywords: Less Than 1% Error; Various WaveShapes; Comparison To Standards; Rep-rated; J-E Characteristic  
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2384  
(PARTICLE BEAMS, ION)  
(Generation)

PRODUCTION OF INTENSE FOCUSED ION BEAMS IN A SPHERICAL MAGNETICALLY INSULATED DIODE  
M.A. Greenspan, D.A. Hamner and R.N. Sudan  
Cornell University, Ithaca, NY 14850

A magnetically insulated ion diode has been constructed with a spherically focusing geometry. The diode has been operated at voltages of approximately 250 and approximately 500 kV, with impedances adjusted to 2-3 and 7-10 ohm, respectively. The pulse length was approximately 85 ns. Total ion currents were  $>30\%$  of the diode current. In the high-voltage case, a focal current density of 2100 A/cm<sup>2</sup> was obtained; this is  $>90$  times the anode ion current density. Auxiliary magnetic fields were used to steer the beam, with the beam deflection as calculated for a single proton. The diode design and diagnostic techniques are described, as well as possibilities for improvements suggested by our data. 20 Refs.

Primary Keywords: Ion Diode; Magnetic Insulation; 250 kV Operating Voltage; Diode Diagnostics  
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2396  
(SWITCHES, OPENING)  
(Mechanical)

EFFECT OF MECHANICAL CONTACT FORCE ON WITHSTAND VOLTAGE OF COPPER-BISMUTH AND CLR VACUUM INTERRUPTERS

D. Lloyd (1) and R. Macken (2)  
(1) Marchwood Engineering Lab, Southampton, UK  
(2) University of Sheffield, Sheffield, UK

Proceedings of the IEE, Vol. 125, No. 11, pp 1275-1278 (11/1975).  
Experiments are described in which the effect of axial compression of the contacts of two commercial vacuum interrupters is examined. The results show that the first few compressions decondition the contacts, but after that the effect is minimal. Spark condition up of the electrodes with an alternating voltage results in the breakdown voltage of the vacuum gap to be the same in both AC and DC case. 9 Refs.

Primary Keywords: Vacuum Interrupter; Dielectric Strength; Surface Condition; DC Voltage; AC Voltage  
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2397  
(PARTICLE BEAMS, ION)  
(Generation)

HIGH VOLTAGE PROTECTION OF HIGH POWER ION SOURCES BY FAST VACUUM TUBE SWITCHES

M. Welkus  
Institut für Plasmaphysik, Garching, FRG  
Symposium Proceedings Fusion Technology, 9th Symposium pp 821-826 (08/1974).

A method is presented for preventing damage to the high voltage accelerating grids of ion sources using vacuum power switches between the power supply and the injector. These switches can also condition the grids against breakdown, automatically recover from a sparkover, and provide pulses of variable duration. Further application as a voltage regulator on current modulator is explored.

Primary Keywords: Ion Source Arc Protection; High Voltage; Vacuum Tube Switching  
Secondary Keywords: Neutral Beam Injection  
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2398  
(PARTICLE BEAMS, ION)  
(Target Interactions)

ION BEAM EROSION OF ROUGH GLASS SURFACES

M. Tarasovich  
Kollman Instrument Corp, Syosset, NY 11791  
Applied Optics, Vol. 9, No. 1, pp 173-176 (06/1979).

Glass, in the final stage of grinding prior to optical polishing, is irradiated with an argon ion beam at a high angle of incidence. A striated surface is produced as individual surface features are sputtered away at different rates depending on the local angle of incidence. The removal of an isolated asperity and the production of a smooth surface through the use of an ion beam are also discussed. 1 Ref.

Primary Keywords: Ion Beam Erosion; Argon Ion Beam; Sputtering  
Secondary Keywords: Surface Polishing; Striated Surface  
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2399  
(BREAKDOWN STUDIES)  
(Gas, Electrical)

TIME LAGS ASSOCIATED WITH ULTRA-HIGH FREQUENCY GAS BREAKDOWN

M. A. Prouse, J.R. Rowbottom and P. G. Monk  
University of Durham, Durham, UK  
Proc. Phys. Soc., Vol. 79, pp 158-170 (02/1961).

This paper deals with the time to breakdown of a gas in a parallel plate gap at 183 MHz. Gap widths ranged from 0.2 cm to 0.5 cm for hydrogen, while the pressure was varied between 1 and 20 torr. Air was tested under approximately the same conditions. Gap widths of 0.2 cm to 0.5 cm were used for neon with pressures up to 161 torr. The time lags measured were broken down into a formative lag and a statistical lag. There were no lags observed in hydrogen, and in air there was no formative lag, but 400 microsecond statistical lags were found. The formative lag in neon was effected when the gap was irradiated with neon light, but not when the gap was varied, meaning perhaps that metastable atoms affected ionization. Both lags had the same magnitude in neon. 12 Refs.

Primary Keywords: Gas Breakdown; AC Breakdown; Ultra-high Frequency; Time Lag; Hydrogen  
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2417  
(PULSE GENERATORS)  
(Flux Compression)

EXPLOSIVE-DRIVEN ENERGY GENERATORS WITH TRANSFORMER COUPLING

F. Harlach  
Katholieke Universiteit Leuven, Leuven, Belgium  
Journal of Physics E: Scientific Instruments, Vol. 12, No. 5, pp 421-429 (05/1979).

The adaptation of inductive-resistive loads to explosive-driven generators by means of pulse transformers is discussed in practical terms. An analytical procedure for optimizing the energy transfer is derived, and conditions are stated under which this is valid. Representative examples of generator-transmission lines and pulse transformers are given, including some experimental results on the performance of a helical/elliptical generator capable of delivering 1 MA into 100 nH. 30 Refs.

Primary Keywords: Pulse Transformers; Energy Transfer Optimization; Inductive-Resistive Loads; Transformer Coupling; Ion Matching  
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2419  
(BREAKDOWN STUDIES)  
(Gas, Electrical)

INFLUENCE OF HUMIDITY ON THE SPARKOVER OF ROD-ROD GAPS OF SEVERAL GEOMETRICAL FORMS SUBJECTED TO POSITIVE IMPULSE VOLTAGES OF VARYING WAVESHAPES

T.E. Allibone and M.L. Allen  
Leeds University, Leeds, UK  
Proceedings of IEE, Vol. 126, No. 5, pp 462-466 (05/1979).

The authors report on an experiment designed to expand standard BS 975:1972 concerning humidity correction. Experiments were performed in which the geometrical shape and spacings of the electrodes and the waveshape of the applied voltage were varied. Self breakdown was observed and found to be at wide variance with the standard in several cases. 12 Refs.

Primary Keywords: Rod-Rod Gap; Atmospheric Air; Lightning; Long Pulse; Horizontally Mounted Gap; Corona Inception  
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2433  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)

THE SOURCE OF HIGH-BETA ELECTRON EMISSION SITES ON BROAD-AREA HIGH-VOLTAGE ALLOY E. CROFTS

N.K. Allen (1), R.V. Keenan (1) and R.M. Croft (2)  
(1) University of Aston, Birmingham, Birmingham B4 7ET, UK  
(2) Central Electricity Research Labs, Leatherhead, Surrey, UK

Journal of Physics D: Applied Physics, Vol. 12, pp 949-972 (02/1979).  
Two recently developed techniques have been used sequentially in an attempt to define the nature of high-beta field emission sites on a commercial alloy broad-area electrode surface. The techniques involved were: (1) an in-situ electron optical method for locating and examining the emission sites; and (2) a high resolution spectrograph for determining the energy spectra of the electrons emitted from these sites. Furthermore, following these measurements, the elemental composition of the emission area was determined by electron microprobe X-ray analysis. Observations, which cast further doubt upon the traditional concept of field enhancing microprojections, indicate that the sites are non-metallic and probably consist of impurities located at cracks or grain boundaries in the surface. Tentative hypotheses are proposed for the emission mechanism and include provision for an unstable situation caused by the effects of adsorbed gas atoms. 12 Refs.

Primary Keywords: Electron Emission; Energy Spectra; Composition of Emission Area; Microprojections; Grain Boundary  
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2436  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES)  
(Gas, Electrical; Surface Flashover)

ANALYSIS OF FLASHES ACCOMPANYING DISCHARGES IN AIR AT DIELECTRIC SURFACES

J. S. Brzosko, A. Konarski, A. Nojedzka, E. Zukowski and J. Grudziński  
Białystok Div, Warsaw University, Białystok, Poland  
J. Phys. D: Appl. Phys., Vol. 9, pp 2369-2377 (04/1976).

Experiments were done in which the flashes accompanying discharges at the surface of a dielectric were examined using a linear photomultiplier. The dielectric constant was shown to have an effect on the flash-energy spectra when analyzed with respect to time and the applied electric field. Two different types of discharges were observed: high energy, low intensity sparks, and low-energy, high-intensity sparks. 19 Refs.

Primary Keywords: Discharge; Dielectric Surface; Air Discharge; Flash Energy Spectra  
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2437  
(SWITCHES, CLOSING; BREAKDOWN STUDIES)  
(Gas Gaps, Electrical; Gas, Electrical)

ARC VOLTAGE OF PULSED HIGH CURRENT SPARK GAPS

T.E. James and J.L. Browning  
Culham Lab, Abingdon, Oxfordshire, UK  
International Conference On Gas Discharges, London, U.K., pp 318-322 (09/1970).

Experiments are described in which arc voltage measurements are made in a triggered three-electrode spark gap as a capacitor is discharged into an inductive load. The peak current, the pressure and the pulse length are varied, and their effects on the arc voltage are observed. Measurements were taken in both argon and air. A general expression for pulsed arc voltage is derived. 6 Refs.

Primary Keywords: Spark Gaps; High Current; Arc Voltage Measurement; Pressure Variation; Pulse Length Variation  
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2438  
(PARTICLE BEAMS, ION, PARTICLE BEAMS, ELECTRON)  
(Generation, Target Interactions)

COLLECTIVE ACCELERATION WITH INTENSE ELECTRON BEAMS

C.L. Olson  
Sandia Labs, Albuquerque, NM 87115  
IEEE Transactions On Nuclear Science, Vol. NS-22, No. 3, pp. 962-969 (06/1975).

Collective acceleration methods that employ an intense relativistic electron beam (IREB) are discussed. A brief history and a classification of collective acceleration methods are given. Methods examined include IREB injection into neutral gas; IREB injection into vacuum; plasma-filled IREB diodes; and vacuum filled IREB diodes. Accelerating fields of order 1E6 V/cm have been observed experimentally. The collective acceleration processes for IREB injection into neutral gas and vacuum are discussed. It is noted that the collective acceleration processes for IREB diodes have not been elucidated yet. A summary of present collective ion acceleration research areas that involve IREB's is given. 143 Refs.

Primary Keywords: Electron Acceleration; Ion Acceleration; Collective Acceleration; Intense Relativistic Electron Beam  
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2439  
(PARTICLE BEAMS, ELECTRON)  
(Review)

COMPACT HIGH VOLTAGE ACCELERATORS OF CHARGED PARTICLES IN SPACE EXPERIMENTS

A.G. Ponomarenko and R.I. Solovkhin  
Institute For Space & Applied Mechanics, Novosibirsk, USSR  
Acta Astronautica, Vol. 1, pp. 1345-1358 (01/1974).

The authors address the problem of the generation of pulse electric fields in the megavolt range using the limited power sources available in a spacecraft. The electron beams produced could then be used to study the earth's radiation belts and magnetic field. Possible methods of determining the IREB if necessary are discussed. The ion beam acceleration lasers are also discussed. 14 Refs.

Primary Keywords: Particle Beam Generation; Ion Beam Production; Heavy Ion Acceleration; Spacecraft; Earth's Magnetic Field  
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2440  
(ENERGY STORAGE, INDUCTIVE; SWITCHES, OPENING)  
(Systems; Mechanical)  
DEVELOPMENT OF A PULSED HIGH-ENERGY INDUCTIVE ENERGY STORAGE SYSTEM  
J. Tano, O. K. Sonju and J. M. Lontal  
Avco Everett Research Lab., Inc., Everett, MA 02149  
AFAPL Report No. AFAPL-TR-73-49 (08/1973).  
Availability: AD-766518  
NTIS

This work was concerned with the complete investigation and feasibility demonstration of superconducting inductive energy storage systems capable of producing high power pulses in the 200 microsecond range on a repetitive basis. The system studied was a 100 kJ system. A 15 kJ model system was successfully tested. Also, as part of this program, a complete investigation of switches appropriate for short pulse inductive energy storage systems was made. This investigation led to the preliminary development of a multiple contact high speed switch which was successfully tested in model size. 4 Refs.  
Primary Keywords: Superconducting; Energy Storage; Switching; Inductive Energy Storage Coils; Multiple Contact Switches; High Speed Switches; Pulse-forming Networks; High Power Pulses  
Secondary Keywords: Rapidly Changing Currents In A Superconductor; Superconducting Coil Delay Lines

2441  
(ENERGY STORAGE, INDUCTIVE)  
(Systems)  
DYNAMIC CONSTRAINTS ON INDUCTIVE ENERGY STORAGE  
K. M. Schmittner  
Institut für Plasmaphysik, Garching, FRG  
IEEE Sixth Symposium On Engineering Problems Of Fusion Research pp 276-282 (11/1975).

Relations between energy density and discharge rate in inductive energy storage units are considered. The dynamic constraints imposed on the unit size are estimated for the Brooks coil geometry. 0 Refs.  
Primary Keywords: Storage Inductor; Spurious Capacitance; Inductive Load; Brooks Coil  
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2442  
(SWITCHES, CLOSING; BREAKDOWN STUDIES)  
(Vacuum Gaps; Self; Vacuum; Electrical)  
EFFECTS OF VOLTAGE POLARITY, ELECTRIC CURRENT, EXTERNAL RESISTANCE, NUMBER OF SPARKINGS, SUPPLY FREQUENCY, AND ADDITION OF HYDROGEN AND AIR ON ELECTRICAL BREAKDOWN IN VACUUM  
R. Hackam  
University of Sheffield, Sheffield, UK  
Journal Of Applied Physics, Vol. 46, No. 9 pp. 3789-3799 (01/1975).

The breakdown potential of a vacuum gap is measured using parallel planar electrodes made of sterling silver as a function of gap separations, number of sparkings, external resistance, and variation of hydrogen and air pressures using DC and AC (50 Hz) applied voltages. It is found that the DC and AC vacuum breakdown voltages become equal after full conditioning by repeated sparkings of both electrodes either with AC or with both polarities of the DC applied voltage. The vacuum breakdown voltage is found to be independent of supply frequency up to 250 Hz. The vacuum breakdown voltage decreases with decreasing the external circuit resistance in series with the gap in the range below 1000 ohms. This decrease in the breakdown potential is attributed to the very short discharge time of the stray capacitive energy of the connecting leads into the gap compared to the time necessary for the current growth leading to breakdown. The minimum energy necessary to decondition (degrade) a vacuum gap is measured and the degree of deconditioning is determined as a function of energy discharged into the gap. The DC dielectric strength of the vacuum gap always recovers to its original value after a few sparkings. 50 Refs.

Primary Keywords: Vacuum Gaps; Breakdown Potential; Planar Electrodes; Rep Rate; Gap Recovery; Gap Conditioning  
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2443  
(PARTICLE BEAMS, ELECTRON)  
(Target Interactions)  
INTENSE RELATIVISTIC ELECTRON BEAM INTERACTION WITH A COOL THETA PINCH PLASMA  
D. A. Hammer, K. A. Gerber, M. F. Dove, G. C. Goldenbaum, B. G. Logan, K. Papadopoulos and A. W. Ali  
Naval Research Lab., Washington, DC 20375  
NRL Memorandum Report No. 3439 (01/1977).  
Availability: AD A036308  
NTIS

Experimental results are presented for the heating of a 4 m long plasma confined by a uniform magnetic field of 4-5 kg by an intense relativistic electron beam. The initial plasma density ranged from approximately  $5 \times 10^{13}/\text{cu. cm.}$  to approximately  $1 \times 10^{15}/\text{cu. cm.}$ , the lower density cases being partially ionized and the higher density cases highly ionized. In all cases, the energy coupled from the beam to the plasma is greater than can be explained by binary collisions between beam electrons and the plasma particles. Over most of the density range tested,  $5 \times 10^{13}/\text{cu. cm.}$  to  $1.5 \times 10^{15}/\text{cu. cm.}$ , the plasma heating cannot be explained quantitatively by the use of a full nonlinear treatment of the electron-electron two stream instability in the kinetic regime. A review of beam plasma interaction theory and previous experiments is presented to facilitate comparison with the present results. 6 Refs.

Primary Keywords: Intense Electron Beams; Ionization By Electron Beams  
Secondary Keywords: Beam-Plasma Heating

2444  
(BREAKDOWN STUDIES)  
(Reviews)  
IONIZATION IN THE FIELD OF A STRONG ELECTROMAGNETIC WAVE  
Lebedev, P. N.

Physics Institute, Academy of Sciences of the USSR, Leningrad, USSR  
Soviet Physics JETP Vol. 20, No. 5 pp 1307-1314 (05/1965).  
Trans. From: J. Exptl. Theoret. Phys. (USSR) 47, 1945-1957 (November 1964)

Expressions are obtained for the probability of ionization of atoms and solid bodies in the field of a strong electromagnetic wave whose frequency is lower than the ionization potential. In the limiting case of low frequencies these expressions change into the well known formulas for the probability of tunnel auto-ionization; at high frequencies they describe processes in which several photons are absorbed simultaneously. The ionization probability has a number of resonance maxima due to intermediate transition of the atom to an excited state. In the vicinity of such a maximum the ionization cross section increases by several orders of magnitude. The positions and widths of the resonances depend on the field strength in the wave. It is shown that for optical frequencies the mechanism under consideration of direct ionization by the wave field, may be significant in the case of electric breakdown in gases, and especially in condensed media. 8 Refs.

Primary Keywords: Ionization; Multi-photon Absorption; Solids; Gases; (Target Interactions)  
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2446  
(PARTICLE BEAMS, ELECTRON)  
(Target Interactions)  
MAGNETIC-FIELD-INDUCED ENHANCEMENT OF RELATIVISTIC-ELECTRON-BEAM ENERGY DEPOSITION  
D. Mosher and I. B. Bernstein  
Naval Research Lab., Washington, DC 20375  
NRL Memorandum Report No. 3441 (02/1977).  
Availability: AD A037693  
NTIS

The collisional transport of relativistic electron beams in dense, magnetized, high-Z plasmas is characterized by a perturbation solution of the relativistic Boltzmann equation with a Fokker-Planck collision term in the limit of small beam-electron mean-free-path or gyroradius. The general formulation allows for arbitrary magnetic-field, electric-field, and plasma geometries. Analytic solutions in 1-D yield energy-deposition profiles for a magnetized plasma slab. 10 Refs.

Primary Keywords: Relativistic Electron Beams; Energy-deposition Profiles; B-field Enhancement

2448  
(PARTICLE BEAMS, ELECTRON; PARTICLE BEAMS, ION)  
(Transport; Transport)  
RADIANCE AND RADIANT ENERGY DENSITY IN LIGHT OPTICS AND ELECTRON OPTICS ANALOGIES, DIFFERENCES, AND PRACTICAL CONSEQUENCES  
B. W. Schumacher  
Westinghouse Electric Corp., Pittsburgh PA  
Optik, Vol. 45, No. 4 pp. 355-380 (01/1976).

The geometrical-optical description of light is compared to that of corpuscular beams. The differences and similarities in the concepts of radiance, energy flux, spatial energy density, spatial radiation density, and power of a beam as they apply to light optics and electron optics are examined. The analogy showing the refractive index of a medium for a light beam is similar to the beam voltage for an electron beam as used as a basis for the comparison. Special emphasis is placed on the energy carrying and concentration properties of the two types of beams. 16 Refs.

Primary Keywords: Particle Beam Optics; Comparison With Light; Radiance  
Secondary Keywords: Optical Ray Tracing  
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2449  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Reviews)  
SENSORS FOR ELECTROMAGNETIC PULSE MEASUREMENTS BOTH INSIDE AND AWAY FROM NUCLEAR SOURCE REGIONS  
C. E. Baum (1), E. L. Breen (1), J. C. Giles (2), J. O'Neill (1) and G. D. Sower (2)

(1) AFML, Kirtland AFB, NM 87117  
(2) EG&G, Inc., Albuquerque, NM 87114  
IEEE Transactions On Antennas And Propagation, Vol. AP-26, No. 1 pp. 22-25 (01/1978).

For measuring transient electromagnetic fields and related quantities, one needs accurate broadband sensors with simple transfer functions. The various sensor designs developed to achieve this in an optimal manner are summarized. Such sensors are designed for use either in a free space environment (such as in an EMP simulator or on a system under test in such a simulator) or in a nuclear source region that includes local source current and perhaps conductivity. There are now numerous designs which have been iterated for improvements over the last decade. 85 Refs.

Primary Keywords: Sensor; Electromagnetic Pulse; Electromagnetic Field Measurement; Antenna; D-Dot Sensor  
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2450  
(SWITCHES, CLOSING; SWITCHES, OPENING)  
(Reviews)  
SOME SWITCHING PROBLEMS IN THERMONUCLEAR RESEARCH  
D. L. Smart  
Atomic Energy Research Establishment, Harwell, Berkshire, UK  
Paper No. 2932, pp 107-116 (04/1959).

The problems of switching a large amount of energy from a storage device to an inductive load is examined. Several combinations of spark gap, vacuum arc, and mechanical switches that are possible are discussed along with their limitations. Inductive energy storage requires the use of circuit-breakers with a large breaking capacity; several possible arrangements are looked at. 11 Refs.

Primary Keywords: Spark Gap; Loads; Switching System; Ignitron; Circuit Breaker  
Secondary Keywords: Thermonuclear Research  
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# 2451 (BREAKDOWN STUDIES) (Reviews)

THE EXCITATION AND IONIZATION OF ATOMS IN A STRONG RADIATION FIELD  
F.V. Bunkin and A.M. Prokhorov  
P.N. Lebedev Physics Institute, Academy of Sciences of the USSR,  
Leningrad, USSR

Soviet Physics JETP, Vol. 19, No. 3, pp. 739-743 (09/1964).  
Trans. From: J. Exptl. Theoret. Phys. (USSR) 46: 1090-1097 (March 1964)

Some general results are obtained regarding the behavior of atomic systems in a strong radiation field. By the latter is understood a radiation field with such a density that the energy of interaction between it and the atomic electrons approaches that between the electrons and nucleus. It is shown, in particular, that if the interaction time between the atom and field is sufficiently large, atomic ionization will be more probable than its excitation in the bound state, even though the field quantum may be much smaller than the ionization potential. Some estimates of the photoionization potential are presented. 7 Refs.

Primary Keywords: Ionization; Strong Radiation Field; Multi-photon Absorption; Effective Ionizing Field

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# 2455 (PARTICLE BEAMS, ION) (Generation)

A COMPACT 250-KV INJECTOR SYSTEM FOR PIGM

P. N. Hume, R. R. Stevens, J. D. W. Mueller, J. N. Leavitt and H. M. Lederer  
Los Alamos National Lab., Los Alamos, NM 87545  
IEEE Transactions On Nuclear Science, Vol. NS-26, No. 1, pp 1493-1495 (02/1979)

A 250-kV proton injector to be used in the development of a linac suitable for medical applications has been constructed. This injector utilized a spherical Pierce geometry to produce a converging beam. A gas-insulated accelerating column is cantilevered on a grounded vacuum system, with a separate high voltage equipment dome connected to a 100-kV Cockcroft-Walton power supply. The injector can be operated locally or remotely, with the remote control accomplished by a microprocessor system linked to a central control minicomputer. This injector has been designed as a low-cost compact system. The design details and the data obtained during initial operation are presented. 5 Refs.

Primary Keywords: LINAC; Low Current; Medium Energy; Proton Beam

Secondary Keywords: Medical Application

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# 2503 (PARTICLE BEAMS, ELECTRON; ENERGY CONVERSION, ELECTRICAL) (Generation; Power Supplies)

PROTECTING A HIGH-VOLTAGE ELECTRON GUN POWER SUPPLY FROM BREAKDOWNS  
A.G. Kiyukov and V.M. Lebedev  
Soviet Journal Of Optical Technology, Vol. 45, No. 5, pp 312-314 (05/1978)

Systems for protecting an electron gun from short-term shorts across its high-voltage power supply are examined. Protection systems are discussed for low and high power devices as well as low voltage sputtering devices. Magnetic regulators, limiting resistors, self-excited oscillators, and ageing the electrodes are considered. 0 Refs.

Primary Keywords: Interelectrode Breakdown; Magnetic Regulator; High-Frequency Power Supply; Resistive Current Limiting

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# 2521 (DIAGNOSTICS AND INSTRUMENTATION) (Voltage)

AN OPTIMIZED CHARGE SIMULATION METHOD FOR THE CALCULATION OF HIGH VOLTAGE FIELDS

A. Yializis, E. Kuffel and P.M. Alexander  
University of Windsor, Windsor, Ontario, Canada  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-97, No. 6, pp 2434-2440 (11/1977)

A new approach for the computation of electric fields is described, based on the application of optimization techniques to the charge simulation method. The charge simulation technique is briefly considered and the optimized version is formulated. The potential distribution of the rod-plane configuration is solved as a sample problem for comparative purpose, and consideration is given to the solution of field distributions with non-axial symmetry. The new optimized approach proves to be more efficient, minimizing the time required to set up and implement a solution of this kind. 15 Refs.

Primary Keywords: Electrical Field Calculation; Charge Simulation; Optimization Techniques; No Axial Symmetry

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# 2525 (ENERGY CONVERSION, ELECTRICAL) (Power Supplies)

A MULTI-MEGAWATT, VACUUM ARC SWITCHED INVERTER FOR AIRBORNE APPLICATIONS  
R. M. Miller, DC Hopkins, C. J. King, A. Padano, R. Dollinger and A. S. Gilmore Jr.

State University of New York at Buffalo, Buffalo, NY 14226  
1978 IEEE Thirteenth Modulator Symposium, pp 204-207 (06/1978)

In previous papers the single-cycle tests of the operation of a vacuum arc switched inverter have been reported. Now, the High Power Test Facility at the State University of New York at Buffalo has reached a sufficient state of completion to permit more advanced testing of the inverter than has previously been reported. Several of these tests have been completed in which many cycles having peak voltage amplitudes up to 1.6 kV and peak current amplitudes up to 1.5 kA were produced. The switches used in this advanced inverter embody several new refinements in the evolution of electrically controlled vacuum arc switches. The inverter employing these new switches is also refined, with special care being taken to reduce internal power losses in the circuit elements and leads. These tests and refinements emphasize the usefulness of vacuum arc switches in high power inverter applications. 6 Refs.

Primary Keywords: Inverter; High Power; High Frequency; Low Loss

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# 2529 (BREAKDOWN STUDIES) (Electrodes)

ANODE CURRENT DENSITY IN HIGH-CURRENT PULSED ARCS

K. T. Shih  
General Dynamics Corp., San Diego, CA 92112  
Journal Of Applied Physics, Vol. 43, No. 12, pp 5002-5005 (12/1972)

A method has been developed using a split anode to measure the anode current density distribution in high-current pulsed arcs. Rogowski coils were used to detect the current to each half of the split anode as a function of arc position relative to the splitting plane. Transformation equations were derived to obtain local values of current density from the measured lateral distributions. The data were taken using a copper anode in air at one atmosphere with arc current from 750 to 2250 A. The peak anode current densities were found to be between 3.4E5 and 5.5E5 A/sq. cm. 9 Refs.

Primary Keywords: Anode Current Density; Split Anode; Copper Anode; Arc Position; Transformation Equation

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# 2532 (BREAKDOWN STUDIES) (Gas; Optical)

CO/SUB 2/ LASER-INDUCED GAS BREAKDOWN IN HYDROGEN

\* J. Offenberger and N.H. Burnett  
University of Alberta, Edmonton, Alberta, Canada  
Journal Of Applied Physics, Vol. 43, No. 12, pp 4977-4980 (12/1972)

A single-mode CO/sub 2/ laser pulse of approximately 10 MW peak power has been used to induce breakdown at pressures from 50 to 700 Torr in hydrogen. Measurements of the reflected and transmitted laser intensity were obtained and the properties of the resulting spark were studied by means of image converter camera and spectroscopic techniques. At pressures in excess of 100 Torr the spark was observed to grow preferentially towards the focusing lens, while at lower pressures a symmetric expansion was observed. The observed motion was consistent with the existence of a breakdown wave during the rising portion of the laser pulse followed by a laser-supported detonation. At pressures greater than 100 Torr, significant reflection ( $\geq 2^\circ$ ) was observed during the detonation phase. 11 Refs.

Primary Keywords: CO/sub 2/ Laser; Hydrogen Gas; Low Pressure; Spectroscopic Spark Diagnostic; Transmitted Radiation; Reflected Radiation

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# 2537 (BREAKDOWN STUDIES) (Vacuum; Electrical)

CURRENTS PRECEDING ELECTRICAL BREAKDOWN IN VACUUM

I.N. Slivko  
Soviet Physics-Technical Physics, Vol. 12, No. 11, pp 1482-1486 (05/1968)

The present-day hypotheses about the mechanism of electrical breakdown in vacuum give different degrees of importance to the role played in the initiation of breakdown by currents flowing between the electrodes before breakdown. Thus, when the breakdown is initiated by field emission from projections on the cathode, or by microdischarges (by current pulses of a duration  $10^{-5}$  -  $10^{-3}$  sec), this current is an immediate cause of breakdown. However, no such straightforward relationship between breakdown and the current flowing before it may exist when the breakdown is initiated by microparticle impact. For this reason, an oscillographic investigation of the prebreakdown current is of particular importance in the case of a slightly nonuniform field between the electrodes when the breakdown mechanism is not entirely clear. This is the subject of this article. 7 Refs.

Primary Keywords: Prebreakdown Current; Microparticle Impact; Nonuniform Field Molybdenum Electrodes; Hemisphere-plane Gap

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# 2539 (DIAGNOSTICS AND INSTRUMENTATION) (Data Transmission)

FAIL-SAFE FIBER-OPTICS DATA BUS USING ACTIVE MULTIMODE MIRROR TERMINALS  
W.B. Sojilman Jr., P.L. Gravel and R.A. Soref  
Sperry Research Center, Sudbury, MA 01776

Applied Optics, Vol. 17, No. 23, pp 3822-3826 (12/1978)

Low-loss active switching devices are used to construct a fail-safe optical data bus. The system uses only one optical source, and show a low optical loss in the fail-safe mode. The LED sources, PIN photodiode detectors, and the step-under multimode monofibers used are all commercially available, and by using a pulse transformer technique the electrooptic modulation voltages needed can be generated from a 5-V supply which makes the system TTL compatible. 10 Refs.

Primary Keywords: Fiber-optic Data Bus; Electrooptic Mirror Terminal; Low Loss; Single-supply Operation

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# 2541 (SWITCHES, CLOSING; SWITCHES, OPENING)

(Vacuum Gaps; Electrical; Vacuum Gaps, Self)

HIGH REPETITION-RATE, HIGH POWER PULSE TESTS OF VACUUM ARC SWITCHES

R. M. Miller, R. Dollinger and A. S. Gilmore Jr.

State University of New York at Buffalo, Buffalo, NY 14226

1978 IEEE Thirteenth Modulator Symposium, pp 200-203 (06/1978)

Research has been proceeding at the State University of New York at Buffalo on developing vacuum arc switches that can be operated in a pulsed mode. These switches have been demonstrated to have turn-on and turn-off times in the order of microseconds, and recent tests now show that the vacuum arc switch exhibits significant potential for high frequency pulsing applications. These new tests, which have been conducted on vacuum arc switches employed in a series inverter circuit, show that the switches can be reliably turned on by kilovolt level triggers having a rise time on the order of one microsecond. They also show that the switches can be reliably self-commutated to a turn-off mode by the operation of a series resonant circuit placed in series with the load. Combining these two techniques provides reliable pulsing of the vacuum arc switches if the resonant frequency of the resonant circuit is higher than the pulsing rate of the switches. Using this procedure, repetition rates in the five to eight kilohertz range have been reached. 5 Refs.

Primary Keywords: Self-commutation; Series Resonant Circuit; Pulsed, Cathode Igniter

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2547  
(SWITCHES, CLOSING)  
(Vacuum Gaps, Electrical)  
DELAY CHARACTERISTICS OF VACUUM DISC SWITCHES  
G.M. Aretov, V.I. Vasil'ev, M.I. Pergament and S.S. Tsarevnikov  
Soviet Physics-Technical Physics, Vol. 12, No. 1, pp 90-96 (07/1967).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 37, 131-138 (January 1967).  
In a previous article an examination was made of problems regarding the electric strength of vacuum disc spark gaps. In the present article the results of a study of the controllability of such spark gaps are reported. The investigation being confined to vacuum switches with base pressures of  $1\text{E}-1$  to  $1\text{E}-3$  mm Hg in the interelectrode region. 17 Refs.  
Primary Keywords: Vacuum Spark Gap; Delay Measurement; Jitter Measurement; Aquadag; Trigger Circuit  
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2550  
(ENERGY CONVERSION, ELECTRICAL)  
(Power Supplies)  
LIGHTWEIGHT POWER CONDITIONING MAGNETICS

J.P. Walsh, R.L. Houshner and D.L. Lockwood  
Thermal Technology Lab., Inc., Buffalo, NY  
1978 IEEE Thirteenth Modulator Symposium, pp 71-74 (06/1978).  
Recent requirements for lightweight high power magnetics which have led to increased research and development in this and related areas are explained. Transformers with specific weights in the range of 0.1 to 0.25 lbs/KVA have been developed through the utilization of improved materials, improved magnetic circuit modeling, and the application of advanced heat transfer techniques. These thermal aspects are particularly important to the size and weight reduction of magnet cs. If each conductor in a magnetic device can be adequately cooled throughout most of its length, then the current density can be increased and the conductor cross sectional area significantly reduced. This, in turn, results in a smaller core window and consequently, a smaller core. 2 Refs.  
Primary Keywords: Transformer; Small Size; Light Weight; Better Modeling; Thermal Considerations  
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2553  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Particle Beams, Neutral)  
OPTICAL DIAGNOSTICS ON HIGH-POWER NEUTRAL BEAMS  
J.F. Bonnal, C. Braton, C. DeMichelis, J. Druaux, M. Mattioli, R. Oberon and J. Rametto  
EURATOM-CEA Centre d'Etudes Nucleaires, France 92260  
Physics Letters, Vol. 69A, No. 2, pp 116-118 (11/1978).  
A method for measuring the optical emission of a high-energy neutral hydrogen beam is presented. The optical profile thus obtained is found to compare well with the profile obtained by conventional electrical methods. 3 Refs.  
Primary Keywords: Spectroscopy; No Doppler Shift  
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2566  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
ELECTRICAL FIELD BREAKDOWN IN SULPHUR HEXAFLUORIDE  
D.W. George and P.H. Richards  
Marchwood Engineering Lab., Southampton, UK  
British Journal of Applied Physics (Journal Of Physics D), Ser. 2, Vol. 2, pp 1470-1471 (01/1969).  
The breakdown strength of SF<sub>6</sub> at 60 Hz for uniform electric fields has been measured over a wide range of pd from 1E20 to 2E23 mVsup-2/ (pd values at 0 Deg.C. from 5 to 6000 Torr mm) and compared with the dielectric strength of air under the same conditions. 8 Refs.  
Primary Keywords: SF<sub>6</sub>/sup 6/; Uniform Fields; Large pd Range; Comparison With Air  
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2567  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Particle Beams, Neutral)  
A NEUTRAL-PARTICLE ANALYSER FOR PLASMA DIAGNOSTICS  
DDR Summers, R.D. Gill and P.E. Stott  
Culham Lab., Abingdon, Oxfordshire, UK  
Journal Of Physics E: Scientific Instruments, Vol. 11, No. 12, pp 1183-1189 (12/1978).  
We describe an instrument which can be used to measure the neutral-particle flux from a plasma over the energy range 200 eV to 30 keV. This wide range makes the device especially useful for plasmas where neutral injection heating may be employed. It has been used for measuring both the ion temperature and the high-energy spectrum due to the injection of high-power neutral beams into the DITE (Divertor Injection Tokamak Experiment) Tokamak. 12 Refs.  
Primary Keywords: Neutral-particle Flux; 200eV To 30keV; Neutral Injection Heating; Ion Temperature; Energy Spectrum; Tokamak  
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2598  
(SWITCHES, CLOSING)  
(Vacuum Gaps, Electrical)  
ELECTRICAL STRENGTH OF VACUUM DISC SWITCHES  
G.M. Aretov, V.I. Vasil'ev, M.I. Pergament and S.S. Tsarevnikov  
Soviet Physics-Technical Physics, Vol. 11, No. 11, pp 1548-1555 (05/1967).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 36, 2080-2093 (November 1966).  
A study is made of the electrical strength, response time, inductance, and other characteristics of multiple action vacuum disc spark gaps (having an initial pressure of  $1\text{E}-3$  to  $1\text{E}-1$  mm Hg), designed for switching heavy electric currents (up to 2E6 A) at voltages of up to 30 kV. A description is given of the results of an investigation of the dependence of the electrical strength of the spark gaps on the nature and initial pressure of the gas in the region between the electrodes, on the size of the interelectrode gap, and on the number, position, and construction of the metal partitions. Data are presented on the durability of spark gaps of a number of types. 18 Refs.  
Primary Keywords: Vacuum Spark Gap; Hold Off Voltage; Delay Measurement; Switch Inductance; Gas Pressure Variation; Reliability Test  
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2621  
(INSULATION, MATERIAL; SWITCHES, CLOSING)  
(Composite; Molecular Sieve)  
A GAS-PHASE HIGH-VOLTAGE ELECTRICAL ISOLATOR WITH CONTROLLED BREAKDOWN  
J.W. Pye  
Royal Aircraft Establishment, Farnborough, UK  
Journal Of Physics E: Scientific Instruments, Vol. 11, pp 825-829 (08/1978).  
A simple electrical isolation device is described, which incorporates an insulating porous core to assist in electron recombination. Designed for isolating an ion thruster from its mercury propellant feed system, it has resulted in stand-off voltages in excess of 7 kV at normal operating mercury vapour pressures. Breakdown investigations, leading to the final design, have been included and these show that operation as a controlled high-voltage switch is possible. Some of the life-limiting operating factors have been identified. 25 Refs.  
Primary Keywords: Insulator; Vapor Pockets; Mercury Vapor; Insulating Balls; Porous Insulator  
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2635  
(SWITCHES, CLOSING)  
(Vacuum Gaps, Materials)  
ELECTRODE EROSION IN VACUUM GAP BREAKDOWN BY NANOSECOND PULSES  
G.A. Mesyats and V.I. Eshkonazi  
Soviet Physics Journal, Vol. 11, No. 2, pp 79-82 (02/1968).  
Trans. From: Izvestiya Vysshikh Uchebnykh Zavedenii. Fizika 11, 123-125 (1968).  
In studies of high-vacuum electrical breakdown much attention has been allotted to electrode erosion. However, only the instant of initiation of the complete breakdown stage have been considered. We studied the erosion on electrodes under pulsed breakdown of a 0.35 mm gap at 35 kV for various pulse lengths. 6 Refs.  
Primary Keywords: Electrode Erosion; 35 kV Operating Voltage; Variable Pulse Duration  
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2670  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
ORIGIN OF STRIATIONS DUE TO MECHANICAL EFFECTS IN FAST WIRE EXPLOSIONS  
S.M. Smith  
Stevens Institute of Technology, Hoboken, NJ 07030  
Journal Of Applied Physics, Vol. 41, No. 10, pp 3918-3921 (09/1970).  
The suggestion that mechanical oscillations in the solid wire are in part responsible for the production of striations observed in a class of wire explosion is investigated using the dispersion relation for elastic waves in isotropic solid cylinders. It is proposed that these oscillations arise due to the transient nature of the electrical energy deposition and that axial waves originate at points of discontinuities such as impurities and grain boundaries. Numerical solutions are obtained using the first shear- and dilatational-mode cutoff frequencies, and the wave numbers of these and standing waves are presented as a function of Poisson's ratio. Experimental data on the average distance between striations and new data are found to lie within the range predicted by the theoretical analysis. 11 Refs.  
Primary Keywords: Exploding Wire; Striations; Mechanical Oscillation; Dispersion Relation; Elastic Wave; Theory; Numerical Calculation  
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2692  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
PROCESSES INVOLVED IN THE TRIGGERING OF VACUUM BREAKDOWN BY LOW-VELOCITY MICROPARTICLES  
P.A. Chatterton, M.M. Monon and K.D. Srivastava  
University of Waterloo, Waterloo, Ontario, Canada  
Journal Of Applied Physics, Vol. 43, No. 11, pp 4536-4542 (11/1972).  
The role of low-velocity microparticles (diameters < 100 micron; velocities approximately 10-50 m/sec) in inducing breakdown in a high vacuum gap is investigated. On the basis of a simple model, it is shown that as an anode initiated microparticle approaches the cathode, fields sufficient to cause appreciable field emission ( $> 1\text{E}9$  V/m) are possible at the cathode surface. The emission current not only causes partial neutralization of the initial charge on the microparticle, but also raises the temperature ( $> 2000$  K) of the particle surface. As a consequence, a significant increase in gas pressure (approximately 100 Torr) in the microvolume between the cathode and the particle is possible, resulting in a discharge between the two. Such a discharge could act as a trigger for the breakdown of the main gap. Other possible processes that could arise at the onset of melting or boiling of the bombarded surface, and which may lead to breakdown of the entire gap, are also discussed. 29 Refs.  
Primary Keywords: Microparticle; 10-50 m/sec Velocity; 100 Micron Diameter; Vacuum Gap; Gas Liberation  
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2717  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
PULSED BREAKDOWN OF AIR IN A HOMOGENEOUS FIELD AT LARGE OVERVOLTAGES  
V.V. Vorob'ev and A.M. Iskol'dskii  
Soviet Physics-Technical Physics, Vol. 11, No. 11, pp 1560-1562 (05/1967).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 36, 2095-2098 (November 1966).  
We have carried out an investigation of the mechanism of electron breakdown in atmospheric air at pressures p=45 to 760 mm Hg with electrode separations d=2 to 5 mm using electron-optical and osiloscopic methods. Breakdown was initiated in a spark gap located either at the end of or at an interruption in a coaxial line with a characteristic impedance of p=75 ohm. The gap was fed with rectangular voltage pulses of duration  $T_{\text{sub}} \approx 30$  nsec (the rise time  $T_{\text{sub}}/4$  of the leading edge was approximately 1 nsec) and amplitude  $U_{\text{sub}} \approx 10$  to 50 kV; the pulses were formed by a high voltage line generator. 4 Refs.  
Primary Keywords: Uniform Field; Impulse Breakdown; High Overvoltage; Air Gas; Variable Pressure; Variable Gap Spacing  
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2718  
(ENERGY STORAGE, MECHANICAL)

(Rotating Machines)  
CIRCUIT AND MAGNETIC ANALYSIS FOR A SYSTEM OF FARADAY ROTATOR COILS  
DRIVEN BY A TWO-SPOOL, FOUR-ROTOR HOMOPOLAR GENERATOR  
D.J. Mayhall (1), W.F. Weldon (1), H.M. Woodson (1), K.M. Toik (2) and  
H.G. Rylander (2)  
(1) University Of Texas At Austin, Austin, TX 78712  
(2) Department Of Energy  
(01/1977)  
Availability: CONF-771029-119  
NTIS

As part of a cost optimization study, a computer based circuit analysis is performed to determine the energy storage requirements a homopolar generator must meet to drive an inductive load of Faraday rotator coils, which is an option considered for the Lawrence Livermore Laboratory (LLL) Shiva laser system upgrade. The reference load consists of five parallel sets of three different size sclerol coil in series. Each coil is modelled as a series inductance and resistance. The homopolar is modelled as a capacitance in series with a resistance and an inductance. The transmission lines connecting the homopolar and the coils are modelled as series inductances and resistances. The initial homopolar voltages and energies to create the required coil magnetic fields are obtained versus the small coil turns, homopolar capacitance, and line length, as are the times to current maximum, peak homopolar currents, and peak coil currents. For 50 ft lines, the minimum initial homopolar voltage varies from 20 to 17 MV. The axial magnetic field variation in the rotator glass is 1.0X. The stored energy for the thickest coils is 2.4 times that of the thinnest coils. (ERA citation 03-025500)

Primary Keywords: Electric Generators; Tokamak Type Reactors; Costs; Electronic Circuits; Energy Storage; Optimization; Specifications  
Secondary Keywords: ERDA/700203; DC Generators; Computer Applications; Cost Engineering; NTISDE

2724  
(SWITCHES, CLOSING)

(Gas Gaps, Electrical)  
DEVELOPMENT OF THE SWITCHING COMPONENTS FOR ZT-40  
J.G. Melton, R.S. Dike, K.W. Hanks and W.C. Nunnally  
Los Alamos National Labs, Los Alamos, NM 87545  
No. CONF-771029-23, 4p (01/1977)  
Availability: LA-UR-77-2440  
NTIS

Switching of the main capacitor banks for ZT-40 will be accomplished by spark gap switches. Initially, there will be 576 spark switches and 288 crowbar switches. A development program is under way to develop three switches: (1) a versatile start switch, which can be used for both the 1/sub Z/ and the 1/sub theta/ capacitor banks, with a wide operating voltage range, (2) a crowbar switch which is capable of crowbaring the circuit without the power crowbar bank, and (3) a power crowbar switch, which can handle 50 to 100 coulombs, so that a large number of crowbar switches will not be required when the power crowbar circuit is added. The problems with the start switches and the first crowbar switch have been solved, or alleviated. The development of a power crowbar switch has just begun. (ERA citation 03-016258)

Primary Keywords: Power Supplies; Switches; Zt-40 Device; Capacitors; Design; Energy Transfer; Spark Gaps  
Secondary Keywords: ERDA/700203; NTISDE

2725  
(SWITCHES, CLOSING)

(Gas Gaps, Materials)  
RECOIL MOMENTUM AND EJECTION OF METAL PARTICLES UNDER THE ACTION OF A GIANT LASER PULSE  
A.M. Bonch-Bruyevich and Ya.A. Ivas  
Soviet Physics-Technical Physics, Vol. 12, No. 10, pp 1407-1409  
(04/1966)  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 37, 1917-1920 (October 1967)  
The effect of laser radiation with a density exceeding the critical one on a metal target is a rapid heating of a certain metal layer and ejection of metal particles in the form of vapors and drops, the entire target acquiring a certain recoil momentum. The magnitude of this recoil momentum for a number of metals is given for light flux densities  $\sim 10^8$  W/sq.cm. (continuous wave laser), and for a approximately  $\sim 10^{11}$  W/sq.cm. on which basis some conclusions can be drawn on the damage mechanism. 4 Refs  
Primary Keywords: Laser-metal Interaction; Mass Ejection; Krypton Laser; Threshold Intensity; Surface Micrograph  
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2727  
(SWITCHES, CLOSING)

(Gas Gaps, Electrical)  
MULTICHANNEL, HIGH-ENERGY RAILGAP SWITCH  
G.R. Neil and R.S. Post  
University of Wisconsin, Madison, WI  
The Review Of Scientific Instruments, Vol. 49, No. 3, pp 401-403  
(03/1978)  
A low inductance, multichannel railgap switch has been developed which is capable of switching 20 kJ at 500 kA. The switch has low jitter, a wide operating voltage range and low electrode erosion rate. 1 Ref  
Primary Keywords: Railgap Switch; Multichannel Operation; Low Inductance; Low Jitter; Low Electrode Erosion Rate  
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2745  
(ENERGY STORAGE, MECHANICAL)

(Rotating Machines, Materials)  
TEST DATA ON ELECTRIC CONTACTS AT HIGH SURFACE VELOCITIES AND HIGH CURRENT DENSITIES FOR HOMOPOLAR GENERATORS  
M. Brennen (1), W.F. Weldon (1), H.M. Woodson (1), H.G. Rylander (2) and K.M. Toik (2)  
(1) University Of Texas At Austin, Austin, TX 78712  
(2) Department Of Energy  
(01/1977)  
Availability: CONF-771029-121  
NTIS

Test data is presented for one grade of copper graphite brush material, Poragrite CM15, over a wide range of surface velocities, atmospheres, and current densities that are expected for fast discharge (<100 ms) homopolar generators. The brushes were run on a copper coated 7075-T6 aluminum disk at surface speeds up to 277 m/sec. One electroplated copper and three flame sprayed copper coatings were used during the tests. Significant differences in contact voltage drops and surface mechanical properties of the copper coatings were observed. (ERA citation 03-025502)

Primary Keywords: Electric Generators; Reference Theta Pinch Reactor; Coatings; Copper; Electric Contacts; Graphite; Mechanical Properties; Performance Testing; Power Supplies  
Secondary Keywords: ERDA/700203; DC Generators; NTISDE

2754  
(BREAKDOWN STUDIES)

(Gas, Electrical)  
A NEW APPROACH TO COMPUTE UNIFORM FIELD BREAKDOWN OF GASES  
G. Oliver, Y. Gervais and D. Mukhedkar  
Ecole Polytechnique De Montreal, Montreal, Quebec, Canada  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-97, No. 3, pp 969-976 (06/1978)  
This paper presents a direct method for computing the uniform field breakdown of gases. An equation is derived for calculating the breakdown voltage of a uniform field gap as a function of gas density and gap length. The equation has been verified for several common gases for a wide range of voltage and pressure. 1 Refs  
Primary Keywords: Uniform Field; DC Voltage; AC Voltage; Breakdown Voltage Determination; Several Gases  
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2755  
(ENERGY CONVERSION, ELECTRICAL)

(Power Supplies)  
A VERSATILE HIGH-VOLTAGE BIAS SUPPLY FOR EXTENDED RANGE MIS C(V) AND G(V) MEASUREMENTS  
P. Kuczer, H.C. Hook and A.M. Goodman  
RCA Labs, Princeton NJ 08540  
NBS Report No. NBS SP 400-41 (12/1977)  
Availability: PB 274 939  
NTIS

Recently developed technology has enabled the measurement of MIS C(V) and G(V) at bias-voltage magnitudes as large as 25 kV. This report describes a versatile high-voltage power supply intended for use as a bias source in carrying out such measurements. The design allows the user a wide variety of options in the selection of the sweep function (waveform), sweep time, initial bias voltage, and the amplitude of the bias sweep. There are six possible sweep functions: (i) increasing ramp, (ii) decreasing ramp, (iii) positive polarity half-wave sawtooth increasing ramp followed by decreasing ramp, (iv) negative polarity half-wave sawtooth decreasing ramp followed by increasing ramp, (v) full-wave sawtooth starting with increasing ramp, and (vi) full-wave sawtooth starting with decreasing ramp. Either single or repetitive sweeps may be selected. The sweep time from the initial value to the end of the first ramp segment may be varied from 1 to 2000 s. Operator convenience is enhanced by certain features of the design, among these are light-emitting diodes which display the state of the sweep and automatic on control if the sweep is used with an x-y recorder. 5 Refs  
Primary Keywords: Bias Supply; 25 kV Voltage Range; High-voltage Sweep; Single Sweep; Repetitive Sweep; High-voltage C(V) And G(V) Measurement

2779  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)

(Gas, Optical; Gas Gaps, Optical)  
PRESSURE DEPENDENCE OF THE RISE TIME OF LASER-TRIGGERED SPARK GAPS  
J.C. Scott and A.W. Palmer  
City University, St. John Street, London  
Journal Of Physics E: Scientific Instruments, Vol. 11, pp 495-496  
(12/1977)  
The laser-triggered spark gap (LTSG) has found uses in many applications where ultra-fast voltage transitions are required, primarily because of its reliability of operation, simplicity of construction and speed of response. The LTSG can be incorporated into most coaxial systems with minimum change of impedance, a necessary condition to achieve fast electrical switching. In this communication we report on our practical measurements of the rise times generated by the LTSG which show that, for a certain gap setting, there is a minimum rise time that may be achieved and that the parameters, voltage and pressure, which are determined theoretically to give this minimum rise time are in reasonable agreement with the practically measured values. 6 Refs  
Primary Keywords: Laser-triggered Spark Gap; Deviation From Paschen's Law; Experiment; Comparison With Theory  
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2784  
(BREAKDOWN STUDIES)

(Surface Discharge)  
SPARK DISCHARGE OVER THE SURFACE OF FILMS OF DIFFERENT COMPOSITION  
W.N. Vukobratovic and E.V. Denkel  
Soviet Physics-Technical Physics, Vol. 12, No. 10, pp 1416-1418  
(04/1966)  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 37, 1927-1929 (October 1967)  
Investigations of space and time scans of the channel of a surface discharge and of the charged particle density in the plasma of the channel of a surface discharge have shown that the luminous channel becomes flat and pressed against the surface over which the discharge occurs, whereas the charged particle density in the discharge channel is distributed nonuniformly and increases with approach to the surface. In view of this result it was of interest to determine the effect of the surface on the formation and development of a surface discharge. An investigated discharges over the surface of films deposited on different substrates. 3 Refs  
Primary Keywords: Surface Discharge; Current Pressing; 10/0sub 2/ Film; Several Substrates; Spatial Resolution; Temporal Resolution  
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2798  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
MEASUREMENT OF NANOSECOND HV TRANSIENTS WITH KERR EFFECT  
E.E. Bergmann and G.P. Kolosov  
Lehigh University, Bethlehem, PA  
Review Of Scientific Instruments, Vol. 48, No. 12, pp 1641-1644  
(12/1977)  
A technique for measuring the high-voltage transients associated with low inductance, pulsed gas discharges is described. Measurements are made directly at the 10-kV level with a transmission line Kerr cell and narrow-width, pulsed dye laser, synchronized with the test discharge. The data indicates a temporal resolution of 2 ns. 9 Refs.  
Primary Keywords: Kerr Effect; Laser Synchronizing Pulse  
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2813  
(POWER CONDITIONING)  
(Pulse Transformers)  
THE PREDICTION OF PULSE PERMEABILITY AND LOSS OF NI/FE ALLOYS IN TOROIDAL CORE PULSE CURRENT TRANSFORMERS  
P.C. Hoque and A.R. Piracy  
Brighton Polytechnic, Moulsecomb, Brighton, BN2 4GJ, UK  
Journal of Physics D: Applied Physics, Vol. 11, pp 937-944 (11/1977).  
Measurements of pulse permeability and loss of Ni/Fe toroidal cores in the unidirectional pulse current transformer mode are reported. These are discussed in comparison with the classical eddy current theory and an improved empirical model is proposed. 4 Refs.  
Primary Keywords: Unidirectional Pulse Transformer; Eddy Current Theory; Empirical Model; Experiment; Theory  
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2814  
(SWITCHES, CLOSING; POWER CONDITIONING)  
(Gas Gaps; Self Transient Suppressors)  
AN ELECTRICAL SURGE ARRESTOR (ESA) MODEL FOR ELECTROMAGNETIC PULSE ANALYSIS  
C.T. Kleiner, E.D. Johnson, L.R. McMurray and F.T. Suzuki  
Pekowell International Electronics Operations, Anaheim, CA 92803  
IEEE Transactions On Nuclear Science, Vol. NS-24, No. 6, pp 2352-2356  
(12/1977)  
Electrical Surge Arrestors (ESAs) have been used extensively for lightning and EMP protection. These components are characterized by (a) presenting an open circuit (high impedance) below the gap breakdown potential, (b) becoming a virtual short circuit above the gap breakdown and (c) displaying a significantly higher level of apparent gap breakdown for very fast input voltage rise-times (dv/dt). This paper describes a mathematical model for a spark gap surge arrester which has been used successfully to characterize ESA response to the following stimulus: 1. Below DC Gap Breakdown 2. At or above Gap Breakdown 3. At high apparent Gap Breakdown voltage as a function of increased rise-time 4. Damped Sinewave Input (below and at Gap Breakdown) 5. Exposed to prompt gamma radiation using a Flash X-Ray source and an electrical input. 5 Refs.  
Primary Keywords: Surge Arrester; Spark Gap; Modeling; Analysis  
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2827  
(SWITCHES, CLOSING)  
(Miscellaneous Solid State)  
SUBNANOSECOND SWITCH FOR USE IN SHOCK WAVE EXPERIMENTS  
T.T. Cole and J.W. Lytle  
Lawrence Livermore Lab, Livermore, CA 94550  
The Review Of Scientific Instruments, Vol. 48, No. 8, pp 1258-1259  
(08/1977)  
A subnanosecond selenium switch has been developed for use in shock wave experiments. Bulk selenium makes a transition to the metallic state at a pressure of 128 kilobars, with a resistivity decreasing by a factor of about 1E11 from the value at atmospheric pressure. A shock wave traversing the selenium film in a direction normal to the film induces the transition. 2 Refs.  
Primary Keywords: Selenium Switch; Metallic State; Pressure Transition; IE11 Resistivity Decrease; Shock Wave Induced Resistance Change  
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2835  
(SWITCHES, OPENING; REVIEWS AND CONFERENCES)  
(Conferences; Conferences)  
SYMPOSIUM PROCEEDINGS NEW CONCEPTS IN FAULT CURRENT LIMITERS AND POWER CIRCUIT BREAKERS  
G. Bates Ed. (1), R. Kennon Ed. (1) and A.S. Gilmour Ed. (2)  
(1) Electric Power Research Institute, Palo Alto, CA 94304  
(2) State University of New York at Buffalo, Buffalo, NY 14226  
EPRI Report No. EPRI EL-276-SP (09/1976)  
Availability: EPRI EL-276-SP  
EPRI  
Serious industry attention is being directed toward developing fault current limiters and improving power circuit breaker interrupters through R&D programs at EPRI, ERDA, and other research organizations. Many of these projects have begun to provide important findings so this symposium was held on September 28, 29, and 30, 1976, at the State University of New York at Buffalo (SUNYAB). The symposium was equally divided between papers and open discussions among the participating researchers, designers, application engineers, and utility operations personnel. Participants expressed their views and opinions openly. The subject of power circuit breakers was covered from the fundamental aspects of arc physics to design and development of actual interrupters. Development of gas, vacuum and combination interrupters was described. Both switched resistor and turned fault current limiters were presented. Considerable general discussion centered around potential application and need for fault current limiters. Two electric utility papers were presented on the subject of Applications. 125 Refs.  
Primary Keywords: Fault Current Limiter; Arc Voltage; Fault Sensing; Arc Interruption; Power Circuit Breaker; Arc Modeling  
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2864  
(BREAKDOWN STUDIES)  
(Surface Flashover)  
PROPAGATION VELOCITY OF CATHODE-INITIATED SURFACE FLASHOVER  
R.A. Anderson  
Sandia Lab., Albuquerque, NM 87115  
Journal Of Applied Physics, Vol. 48, No. 10, pp 4210-4214 (10/1977).  
A polymethyl methacrylate insulator rod in vacuum is stressed by high-voltage pulses having 3-ns rise times, with the result that 40-mm-long incomplete discharges occur at the cathode end of the rod. Time-resolved measurements of electron emission from different areas on the insulator surface indicate that a discharge propagates toward the anode at approximately 2E7 m/s during a pulse. A velocity of this order is expected if surface flashover results from an avalanche of electrons due to secondary emission at the insulator surface. Dependence of the velocity on the angle of the electric field relative to the insulator surface is predicted. 14 Refs.  
Primary Keywords: Pulsed Surface Flashover; Vacuum Insulator Interface; Cathode-Initiated; Secondary Emission  
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2872  
(ENERGY STORAGE)  
(Rev Mus)  
ENERGY STORAGE OPTIONS FOR SHIVA UPGRADE  
B. Gander and B. Gagnon  
Lawrence Livermore Lab, Livermore, CA 94550  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIB-9 (11/1976).  
The Shiva Glass Laser at LLNL will use 20-25 MJ of Capacitive Energy Storage. An improved laser system is proposed that will increase this energy requirement by a factor of ten: 25 MJ for Faraday rotators, and 150 MJ for flashlamps. This paper discusses alternative options to capacitors for driving both kinds of loads. Included are homopolar generators that discharge in approximately 0.1 seconds that will drive Faraday rotators directly. Similar generators can be used to drive inductive stores for flashlamp power. The features of the flashlamp system include a wide distribution of 10 kJ load elements, and a half-millisecond discharge time requirement. The possibilities of providing open-switching for inductive storage and of driving many flashlamps in parallel are discussed. 5 Refs.  
Primary Keywords: Capacitive Energy Storage; Capacitor; Energy Storage; Homopolar Generator; Inductive Energy Storage  
Secondary Keywords: Shiva Glass Laser  
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2881  
(ENERGY STORAGE, MECHANICAL)  
(Rotating Machines)  
CONTROLLABLE HOMOPOLAR MOTOR-GENERATOR ENERGY STORAGE FOR APPLICATION IN A FUSION POWER REACTOR  
W.Y. Chen, W.E. Toffolo and J.R. Purcell  
General Atomic Co., San Diego, CA 92121  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIB-3 (11/1976).  
Homopolar motor-generators are considered as likely candidates for the energy storage devices to be used in conjunction with rapidly pulsed coils in future fusion reactors. In a tokamak fusion reactor, the induction coil will be pulsed, and it is likely to be superconducting. Then an HMG will be the most economical and efficient energy storage device. However, it is highly desirable to control the HMG effective capacitance in order to shape the induction coil current waveform and utilize the full volt-second capability of the coil. Then it is important to minimize the stored energy in the HMG excitation coils in order to reduce the power required for controlling the HMG. Investigations have been made to optimize the output of a controlled HMG. The excitation coil stored energy and the machine cost are minimized in the process. The study has been concentrated on drum type HMGs. It was found that for an HMG assembly with a total capacity of 1500 MJ, the excitation coil stored energy can be as low as 100 MJ. Thus, the scheme for controlling the effective capacitance of the HMG appears to be feasible. 4 Refs.  
Primary Keywords: Homopolar Generator; Motor-Generator; Output Pulse Shaping; Controllable Excitation Coil  
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2887  
(ENERGY STORAGE, MECHANICAL)  
(Rotating Machines)  
PRELIMINARY ENGINEERING DESIGN OF A PULSED HOMOPOLAR GENERATOR POWER SUPPLY  
W.L. Byrd, W.G. Depp, G.B. Grant, H.G. Rylander, K.M. Folk, W.F. Meldon and J.W. Anderson  
University of Texas at Austin, Austin, TX 78712  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIB-4 (11/1976).  
A 200 megajoule 500 volt homopolar generator system is proposed as the initial storage conversion device for the Texas Experimental Tokamak. The initial engineering design of a 50 megajoule 125 volt homopolar generator module is presented and major components: vacuum field coils, rotor/shaft/bearings, brushes and structure conductors are described in detail. The support for this work was provided by the Energy Research and Development Administration and the Texas Atomic Energy Research Foundation. 0 Refs.  
Primary Keywords: Homopolar Generator; Engineering Design; Component Design  
Secondary Keywords: Tokamak Toroidal Field Coil  
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2888  
(SWITCHES, CLOSING)  
(Vacuum Gaps; Electrically)  
VACUUM BREAK-15 OF VACUUM-ARC SWITCHED MULTI-MEGAWATT INVERTER TESTS  
A. G. Linder and D. A. M. K. K. K.  
State University of New York at Buffalo, Buffalo, NY 14226  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIB-7 (11/1976).  
The high power studies have shown the possibility of using a vacuum arc inverter for high power force commutated or series commutated inverter applications such as application, discussed in this paper, is in the development of a 10-200 volt, multi-megawatt series capacitor inverter circuit. Initial testing has been performed on a 10 kHz vacuum resonant L-C circuit using a VAS. Single pulse tests at 3000 A peak and 5000 V have been very successful. Extensive energy loss studies of the various circuit components result in predicted inverter efficiencies in excess of 95 percent. The tests show that these high efficiencies will be achievable if high quality circuit components are used. The inductors must be fabricated from Litz wire. Low loss materials must be used for the capacitors and distributed components must be made to capacitor elements. The configuration and comparison of the electrodes in the VAS must be such as to minimize the arc voltage drop. 4 Refs.  
Primary Keywords: Vacuum Arc Switched Inverter; Vacuum Gap; Ignitor; Performance  
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- 2899  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Data Transmission)  
SYSTEM FOR DATA ACQUISITION FROM HIGH VOLTAGE TERMINALS  
G.M. York, J. Park, J.J. Mishkinis, D.M. Crandall and V. Pol  
University of Missouri-Rolla, Rolla, MI 65401  
The Review of Scientific Instruments, Vol. 43, No. 2, pp 238-232  
(02/1972)  
An inexpensive data acquisition system has been designed to provide high voltage isolation for data acquisition to analog, digital, and pulse modes. The telemetry system uses GaAs light sources, fiber optics, and phototransistors to accomplish the data transmission. Prewired logic boards have been adapted to accomplish the timing and logic functions. Seven decades of digital data are transmitted error free, pulse data can be transmitted at rates up to 1 MHz, and analog data are transmitted with 0.05% full scale accuracy. 6 Refs.  
Primary Keywords: Fiber Optics; Electrical Isolation; GaAs Diode; Phototransistor; 1 Mhz Bandwidth  
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- 2957  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
THE ROLE OF THE CATHODE ZONE IN THE TRANSITION CORONA EFFECT ARC  
P. Berteault, J. Dupuy and A. Gibert  
Institut Universitaire de Recherche Scientifique, Chemin Philippon, Pau, France  
Journal of Physics D: Applied Physics, Vol. 10, No. 16, pp L219-L222 (11/1977)  
The transition corona effect arc, in atmospheric air, for inter-electrode distances less than a few centimetres in point-to-plane geometry (the high DC positive voltage being applied to the point with the plane at earth potential) is dependent on the existence of a cathode zone and a 'cathode canal'. A sufficient reserve of energy (internal capacity in parallel with the spark gap) permits the 'cathode canal' to develop into a transient arc which is extinguished when the capacity has discharged itself. However, the increasing duration of the cathode zone, with increasing total current, leads to a continuous luminous discharge (named a 'silent' arc) which then evolves into an arc for high currents. 4 Refs.  
Primary Keywords: Atmospheric Air; Cathode Zone; Point-to-plane Geometry; Cathode Canal  
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- 2958  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
THE USE OF A PHOTOMULTIPLIER IN THE DETERMINATION OF IONIZATION COEFFICIENTS IN GASES STRESSED WITH HIGH VOLTAGE  
M.M. Banford and D.J. Tedford  
University of Strathclyde, Glasgow, Scotland  
Journal of Physics D: Applied Physics, Vol. 10, No. 16, pp 2177-2180 (11/1976)  
Experiments using a photomultiplier in the determination of the effective ionization coefficient of ambient room air stressed at very high voltages are described, and the results compared with data previously obtained by conventional current measurement techniques. Good agreement has been achieved, and the advantages of the photomultiplier method are discussed. 8 Refs.  
Primary Keywords: Ionization Coefficient; Air; Photomultiplier; Current Measurement; Uniform-field Gap; Alpha-particle Irradiation  
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- 2976  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Electrodes, Gas Gaps, Recovery)  
THE INFLUENCE OF ELECTRODE HEAT TRANSPORT IN SPARK RECOVERY  
F.L. Curzon and M.S. Gautham  
University of British Columbia, Vancouver, British Columbia, Canada  
British Journal Of Applied Physics, Vol. 18, pp 79-87 (01/1967)  
A one-dimensional model of heat flow in a recovering spark channel is presented, taking into account the effect of electrode heat transport. The theory indicates that the ratio of the times taken for spark channels equipped with different electrodes to achieve the same recovery voltage is constant over a wide range of voltages. The value of the constant depends on the thermal constants of the spark channel and electrode materials. Recovery measurements have been carried out on spark gaps operated in air between tungsten, copper and stainless-steel electrodes. The copper and stainless-steel electrodes were capped by thin tungsten layers to keep the surface properties fixed. The experimental results agree well with the theory provided the recovery voltage lies between 35% and 75% of the final breakdown potential of the spark channel. The results also show that for tungsten electrodes electrode heating has a minor, but significant, effect on the recovery characteristics. 8 Refs.  
Primary Keywords: Spark Recovery; Heat Flow; Modeling; 1-d Simulation; Several Electrode Materials  
COPYRIGHT: 1967 THE INSTITUTE OF PHYSICS, REPRINTED WITH PERMISSION
- 2993  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Surface Flashover; Gas Gaps, Materials)  
AVOIDING FLASHOVERS IN LOW INDUCTANCE HIGH VOLTAGE SPARK GAPS AT ATMOSPHERIC PRESSURE  
M. De Pratis  
Centre d'Etudes Nucleaires, Boite Postale N. 6, 92 Fontenay-aux-Roses, France  
The Review Of Scientific Instruments, Vol. 41, No. 6, pp 887-891 (06/1970)  
The major problem when designing a high voltage spark gap is represented by flashover occurring on the inner surface of the main insulator, and which strongly depend on the insulating materials used as well as on their surface state and shape. For voltages up to 20 or 30 kV, the breakdown distance for flashovers on Teflon is practically linear and almost three times larger than in air. For higher voltages it increases more rapidly and we observed flashes over more than 40 cm occurring within 100 nsec after a potential difference of approximately 100 kV was applied. 2 Refs.  
Primary Keywords: Insulator Flashover; Teflon; Coaxial Spark Gap; Low Inductance; Air Gap  
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- 3006  
(SWITCHES, CLOSING)  
(Gas Gaps, Crossed-field)  
HIGH AVERAGE POWER TESTS OF A CROSSED-FIELD CLOSING SWITCH  
R.J. Harvey (1), R.M. Holly (1) and J.E. Creighton (2)  
(1) Hughes Research Labs, Malibu, CA 90265  
(2) ECRC, Fort Monmouth, NJ 07703  
1976 IEEE Pulsed Power Conference Proceedings, Paper 18-2 (11/1976).  
A triode version of the crossed-field closing switch has been successfully tested at average powers of up to 800 kW for burst durations of 30 s. Unlike most conventional spark gaps, the arc is initiated from a crossed-field glow discharge and occurs at random locations on a shot-to-shot basis. This uniformly disperses the heat loading and erosion over a relatively large electrode surface area which may then be cooled. 4 Refs.  
Primary Keywords: Crossed-field Closing Switch; Triode; Glow Discharge; Performance  
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- 3014  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
IMPULSE FLASHOVER CHARACTERISTICS OF LONG AIR GAPS AND ATMOSPHERIC CORRELATION  
Y. Aihara (1), Harada T. (1), Y. Ito (1) and Y. Aoshima (2)  
(1) Central Research Institute Of Electric Power Industry, Tokyo, Japan.  
(2) Matsushita Electric Mfg. Co., Ltd., Numazu, Japan  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-97, No. 2, pp 342-348 (03/1978)  
The flashover voltages of long air gaps such as rod-rod and rod-plane gaps vary with impulse waveform, polarity, gap spacing and atmospheric conditions. This paper deals with the results of analysis of the flashover characteristics for various impulse waveforms of positive and negative polarities, measured in many laboratories including CRIEPI. New and general relations were found between flashover voltages and the factors mentioned above, thereby enabling determination of flashover voltages under various test conditions. 5 Refs.  
Primary Keywords: Rod-plane Gaps; Rod-rod Gaps; Impulse Flashover; Atmospheric Consideration  
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- 3024  
(BREAKDOWN STUDIES; INSULATION, MATERIAL)  
(Surface Flashover; Insulation)  
BREAKDOWN OF INSULATING MATERIALS BY SURFACE DISCHARGE  
Y. Toriyama (1), M. Okamoto (2) and M. Kanazashi (3)  
(1) Musashi Institute of Technology, Tokyo, Japan  
(2) Central Research Institute of The Electric Power Industry, Tokyo, Japan  
(3) Electrotechnical Lab, Tokyo, Japan  
IEEE Transactions On Electrical Insulation, Vol. EI-6, No. 3, pp 124-129 (09/1971).  
'Round-robin' experiments for partial discharge degradation of polyethylene have been made by means of a parallel-plate electrode system. Following this, a second round-robin was run using direct electrodes with the object of surveying some simple testing methods corresponding to actual phenomena such as local perforation by corona. Corona lifetimes of several insulating materials were measured by using two kinds of electrode systems, i.e., a hemisphere-plane configuration and a cylinder plane as recommended by the International Electrotechnical Commission (IEC). Precise differences between different materials cannot be defined because of the fluctuation of corona lifetime of the same material, but there may be some significance in the order of six kinds of materials. Several possible causes of the variability were examined with regard to the differences of test dates, humidities, airflows, and specimens' thickness and some information concerning relations between variability and experimental conditions was obtained. These results and considerations should be helpful relative to the adoption of the most reasonable electrode and the performance of test procedure. 9 Refs.  
Primary Keywords: Partial Discharge; Local Perforation; Corona; Insulation Lifetime; Test Procedure  
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- 3030  
(DIAGNOSTICS AND INSTRUMENTATION; DIAGNOSTICS AND INSTRUMENTATION)  
(Component Testing; Current)  
MEASUREMENT PROCEDURES FOR CHARACTERIZATION OF HIGH VOLTAGE SPARK SOURCES  
A. Scheeline, D.M. Coleman and J.P. Walters  
University of Wisconsin, Madison, WI  
Applied Spectroscopy, Vol. 32, No. 2, pp 215-223 (04/1978).  
The authors outline methods that can be used to calibrate capacitor discharge spark sources. Procedures and devices needed in the measurement of both individual components and systems used in capacitor charging, and in the control and monitoring of the discharge current are discussed. Characterization methods and their applications to source development is examined. 16 Refs.  
Primary Keywords: Capacitor Discharge Spark Source; Pulse Shape Programming; Spectroscopic Measurement  
COPYRIGHT: 1978 SOCIETY OF APPLIED SPECTROSCOPY
- 3045  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
CALCULATION OF SPARK BREAKDOWN OR CORONA STARTING VOLTAGES IN NONUNIFORM FIELDS  
A. Pedersen  
Technical University of Denmark, Lyngby, Denmark  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-86, No. 2, pp 207-206 (02/1967).  
The processes leading to a spark breakdown or corona discharge are discussed very briefly. A quantitative breakdown criterion for use in high-voltage design is derived by which spark breakdown or corona starting voltages in nonuniform fields can be calculated. The criterion is applied to the sphere gap, and it is shown how it can give a very detailed and accurate description of known breakdown characteristics. 26 Refs.  
Primary Keywords: Gas Breakdown; Spark; Corona; Breakdown Threshold; Nonuniform Field; Theory; Townsend Ionization; Sphere-sphere Gap; Insulation Design Criteria  
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3069  
(BREAKDOWN STUDIES)  
(Gas, Optical)  
BACKGROUND GAS-PRESSURE DEPENDENCE AND SPATIAL VARIATION OF  
SPONTANEOUSLY GENERATED MAGNETIC FIELDS IN LASER-PRODUCED PLASMAS  
R. S. Case Jr. (1) and F. Schürzke (2)  
(1) AFML, Kirtland AFB, NM 87117  
(2) Naval Postgraduate School, Monterey, CA 93940  
Journal of Applied Physics, Vol. 46, No. 4, pp 1483-1498 (04/1975).  
A spontaneous axial magnetic field generated by electron  
currents which flow during the interval that a high-brightness 4-nsec  
full width at half-maximum intensity ruby laser was incident on a  
metallic target has been detected. Its spatial characteristics  
evaluated, and its dependency upon background gas pressure  
investigated both experimentally and theoretically. The propagation  
velocity of the early component of this magnetic field is greater  
than 158 cm/sec, more than an order of magnitude larger than the  
plasma convective velocity, and indicates that the electron currents  
responsible for this fast field must flow through the background  
photoionized gas. The early component is first detected at a pressure  
of 5E-6 Torr, and for a fixed spatial location, reaches a peak  
intensity at a pressure of 2E-3 Torr. Its intensity is typically on  
the order of 1-10 G, a factor 10-100 times smaller than the  
spontaneously generated magnetic fields which are driven by pressure  
gradient effects in the expanding laser plasma. The pressure  
dependence of the pressure gradient magnetic field has also been  
evaluated and compared with previous experimental results obtained  
at laser pulse lengths of greater than 20 nsec. 14 Refs.  
Primary Keywords: Gas Breakdown; Laser Breakdown; Metal Target; Ruby  
Laser; Variable Gas Pressure  
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3079  
(ENERGY STORAGE; INDUCTIVE; ENERGY STORAGE; MECHANICAL)  
(Systems; Machines)  
AN INDUCTIVE ENERGY STORAGE SYSTEM BASED ON A SELF-EXCITED HOMOPOLAR  
GENERATOR  
A. E. Robson, R. E. Lanham, M. H. Lupton, T. J. O'Connell, P. J. Turchi and  
W. L. Wernick  
Naval Research Lab, Washington, DC 20375  
IEEE Sixth Symposium On Engineering Problems Of Fusion Research pp.  
278-302 (11/1975).  
A 10 MJ inductive energy storage system is described in which the  
storage coil is also the excitation coil of a homopolar generator.  
Energy is stored initially in two counter rotating rotors, and  
transferred to the coil when the generator is connected in a  
self-excited mode. The circuit is interrupted by a large  
sulfurhexafluoride circuit breaker working in conjunction with a  
fuse, and delivers energy to a resistive load in approximately 1 ms.  
The system contains a number of novel features, including very  
high speed carbon fiber brushless commutators, intended as a  
prototype module for large energy storage systems. 19 Refs.  
Primary Keywords: Homopolar Generator; High Speed Rotor; Circuit  
Breaker; Sulfurhexafluoride; High Energy  
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3105  
(PULSE GENERATORS)  
(Trigger)  
AVALANCHING TRANSISTORS SPEED UP HIGH-VOLTAGE PULSES  
E. A. Jung  
Argonne National Lab, Argonne, IL  
Electronics Letters, No. 2, pp 73 (01/1977).  
A circuit producing variable pulses of 200-400 volts with rise  
and fall times of 30 ns is designed using a vacuum tube and a transistor.  
A 2 kHz repetition rate at a 1% duty cycle is possible. 0 Refs.  
Primary Keywords: Avalanche Transistor; Vacuum Tube; Fast Rise;  
Hundreds Of Volts Output  
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3131  
(PULSE GENERATORS)  
(Marx)  
STABILIZATION OF THE TIME CHARACTERISTICS OF AN ARKAD'EV-MARX GENERATOR  
I. Yu. Antipov, Yu. V. Kuznetsov, E. V. Lazutin, I. M. Piskarev, V. A.  
Khreshchev and A. V. Shumakov  
Scientific-Research Institute Of Nuclear Physics, Moscow State  
University, Moscow, USSR  
Instruments And Experimental Techniques, Vol. 19, No. 2, pp 429-431  
(04/1976).  
Trans. From: Priory i Tekhnika Eksperimenta 2, 99-100 (March-April  
1976).  
A method is proposed for stabilizing the actuation time delay and  
the fluctuations of this time delay in an Arkad'ev-Marx generator.  
The method allows the output voltage of the generator to be varied  
within limits of approximately 35% without controlling the spark gaps  
and makes it possible to avoid purging the spark gaps during  
operation. 1 Refs.  
Primary Keywords: Arkad'ev-Marx Generator; Jitter Stabilization; Large  
Operating Voltage Range; Trigger Optimization  
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3150  
(ELECTROMAGNETIC FIELD GENERATION; PULSE GENERATORS)  
(Magnetic; Flux Compression)  
EXPLOSIVELY PRODUCED MEGAGAUSS FIELDS AND APPLICATIONS  
C. M. Fowler, R. S. Caird, M. B. Gern and D. J. Erickson  
Los Alamos National Labs, Los Alamos, NM 87545  
IEEE Transactions On Magnetics, Vol. MAG-12, No. 6, pp 1018-1023  
(11/1976).  
We describe various explosive magnetic flux compression devices  
that produce pulsed megagauss fields, and a number of applications in  
which they have been used. Among the systems described are relatively  
simple ones that generate fields up to 250 T in large fixed volumes,  
and cylindrical implosion systems that produce fields in excess of  
1000 T. Small fixed volume systems are described that may be used in  
the laboratory. They require only small amounts of explosive and can  
produce 100 T fields in coils 25 mm long and 10 mm diameter. We  
discuss measurements made on various materials in megagauss fields,  
often at cryogenic temperatures, including magnetoresistance,  
magnetic susceptibility, optical absorption, Faraday rotation, and  
Zeeman splittings. We also discuss experiments in which large  
magnetic pressures have been used to compress solid deuterium  
isotropically. In flux compression devices part of the energy of the  
explosives is converted to electromagnetic energy. This has led to  
their use as compact single-shot high power energy sources. At times,  
it is necessary to transformer couple loads to the device outputs. We  
describe successful operation to transformers in 16 T fields, and  
suggest that they can operate in much higher fields. 22 Refs.  
Primary Keywords: Magnetic Field Generation; Flux Compression;  
Explosive Driven; Laboratory Size Generator;  
Application  
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3151  
(SWITCHES; CLOSING; SWITCHES; CLOSING)  
(Mechanical; Gas Gaps; Self)  
GENERATOR PRODUCING SINGLE NANOSECOND PULSES WITH CONTROLLABLE  
AMPLITUDE AND DURATION  
A. I. Aleksandrin and I. S. Samoilov  
Instruments And Experimental Techniques, Vol. 19, No. 4, pp 1092-1095  
(08/1976).  
Trans. From: Priory i Tekhnika Eksperimenta 4, 142-144 (July-August  
1976).  
A generator is described which produces single nanosecond pulses  
having a rectangular shape with a mechanically computed spark gap  
in hydrogen under a pressure of 50 gauge atmospheres. The amplitude  
of the pulses is 10-5000 V, and the duration of the leading edge is  
0.1 nsec. 7 Refs.  
Primary Keywords: Mercury-Wetted Delay; Peaking Spark Gap;  
Subnanosecond Risettime; 5 kV Operating Voltage; 50  
Atmosphere Pressure  
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3154  
(BREAKDOWN STUDIES; SWITCHES; CLOSING)  
(Gas; Optical; Gas Gaps; Optical)  
CASCADE IONIZATION OF A GAS BY A LIGHT PULSE  
Ya. B. Zel'dovich and Yu. P. Reizer  
Soviet Physics JETP, Vol. 20, No. 3, pp 772-780 (03/1965).  
Trans. From: Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki 47,  
1150-1161 (September 1964).  
The mechanism of ionization of a gas under the action of a light  
pulse is considered. The case is investigated when the pulse power  
and electric field strengths in the light wave are not very large and  
the light-induced emission of electrons is not of decisive  
importance. Under these conditions ionization is of a cascade nature,  
the electrons absorb light quanta in collisions with neutral atoms  
and accumulate energy sufficient for ionization. Approximate  
calculations of the kinetics of development of the cascade are  
carried out by taking into account the most important processes.  
Results of calculation of the breakdown fields are compared with  
published experimental data. 9 Refs.  
Primary Keywords: Laser Ionization; Volume Ionization; Cascade  
Ionization; Low Laser Power; Helium Gas; Argon Gas;  
Ruby Laser; Theory  
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3175  
(BREAKDOWN STUDIES)  
(Gas; Electrical)  
DIELECTRIC BREAKDOWN OF SULPHUR HEXAFLUORIDE IN NEARLY UNIFORM FIELDS  
Y. Kawaguchi, K. Sakata and S. Menju  
Tokyo Shibaura Electric Co. Ltd., Yokohama, Japan  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-90, No. 3,  
pp 1072-1078 (06/1971).  
This paper describes the breakdown potential gradient of sulphur  
hexafluoride (SF/sub 6/) at pressures up to 4 kg/sq.cm. absolute  
against power frequency, switching impulse and standard impulse  
voltages in nearly uniform fields such as plane-plane, sphere-sphere,  
and coaxial cylinder electrode configurations. Electrode material,  
smoothness and polarity effect are also investigated for coaxial  
cylinders. Test results indicate that potential gradient is the most  
influential factor in the dielectric breakdown of SF/sub 6/.  
Switching impulse and standard impulse breakdown at positive polarity  
occur at the potential gradients close to a limiting value of E/P =  
85.1 (kV/cm/kg/sq.cm.) measured by Geballe and Reeves. Breakdown  
potential gradient at negative polarity is below the limiting value  
of E/P at pressures above 1 kg/sq.cm. The negative breakdown seems to  
be more dependent on electrode area and duration of applied voltages.  
9 Refs.  
Primary Keywords: Uniform Field; Several Electrode Materials; Surface  
Condition; Polarity Effect; Power Frequency Voltage;  
Impulse Voltage; High Pressure  
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3185  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
CAPACITIVE MEASUREMENTS OF SLOW FLUCTUATIONS IN HIGH-VOLTAGE SUPPLIES  
FOR ELECTRON MICROSCOPES  
H. P. Rust, K. Weiss and P. Zilske  
Institut für Elektronenmikroskopie am Fritz-Haber-Institut der  
Max-Planck-Gesellschaft, Berlin, GDR  
Journal Of Physics E: Scientific Instruments, Vol. 10, No. 1, pp 71-72  
(01/1977).  
(1 Refs.)  
Primary Keywords: Capacitive Measurement; Low Frequency; Capacitor  
Leakage Current; Leakage Current Drift; Leakage  
Current Error  
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3188  
ELECTRICAL BREAKDOWN AND TRACKING CHARACTERISTICS OF PULSED HIGH  
VOLTAGES IN CRYOGENIC HELIUM AND NITROGEN  
P. A. Heerman and K. D. J. Williamson  
Los Alamos National Labs, Los Alamos, NM 87545  
No. CONF-750116-7, 16p (01/1975).  
Availability: LA-UR-75-1032  
NTIS  
The proposed Scyllac Fusion Test Reactor (SFTR) at the Los Alamos  
Scientific Laboratory (LASL) anticipates using superconducting coils  
as the main energy storage device and will store a total energy of  
450 MJ. The SFTR will operate in a pulsed mode with the  
superconducting energy storage system--NETS (Magnetic Energy Transfer  
System)--experiencing a 60 kV pulsed voltage during each pulsed  
operation. This paper presents experimental data for use by engineers  
in the design of cryogenic apparatus that will be subject to the SFTR  
40 V pulsed waveform. Various electrode configurations were used in  
order to provide the designer with the most commonly used geometries  
over the widest practical range of helium and nitrogen temperatures  
from liquid to room temperature at pressures of 0.9 and 1.6 atm. Data  
are also presented on voltage tracking characteristics of Mylar,  
phenolic, polyethylene, nylon, teflon, and permalloy, which are commonly  
used structural dielectric materials.  
Primary Keywords: Scyllac Devices; Specifications; Dielectric  
Materials; Breakdown; Cryogenics; Electric Potential;  
Electrical Insulation; Helium; Nitrogen;  
Superconducting Magnets  
Secondary Keywords: NTISERDA

3191  
(PULSE GENERATORS; POWER CONDITIONING)  
(LC; Pulse Transformers)  
CIRCUIT FOR SHAPING SHORT HIGH-VOLTAGE PULSES  
M.I. Elagin, V.V. Starykh and S.D. Fanchenko  
Institute of Atomic Energy, Moscow, USSR  
Instruments And Experimental Techniques, No. 2, pp 438-439 (04/1970).  
Trans. From: Priroda i Tekhnika Eksperimenta 2, 114-115 (March-April 1970).

The paper describes a generator which produces single pulses and solves the problem of producing short high-voltage pulses at a power level of 162 to 183 MW across the circuit of a plasma turn. The pulses are produced in the secondary winding of a coreless transformer. Two sets of voltage spark gaps and a nonlinear voltage resistor are used as the commutating elements. Single pulses having a length of 0.3 microsecond and an amplitude of up to 42 kV are obtained. 2 Refs.

Primary Keywords: Pulse Transformer; Air Core Transformer; Spark Gaps; LC; Pulse Length  
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3198  
(SWITCHES; CLOSING)  
(Gas Gaps; SF<sub>6</sub>; Self-Clearing)  
SF<sub>6</sub> SWITCH RECOVERY TIME HIGH-VOLTAGE SWITCH  
M. Dufour, M. Egner and A. Seeliger  
Institute of Applied Physics, Univ. Berne, Switzerland  
Rev. Sci. Instrum., Vol. 47, No. 12, pp 1552-1553 (08/1976).

A novel, sealed-off, low-pressure quenching discharge gap capable of switching voltages up to 25 kV has been built. A recovery time of a few microseconds was measured, allowing switching rates in the 100 kHz range. 2 Refs.

Primary Keywords: Very Low Pressure Gaps; Short Recovery Time; Porous Electrodes; High Resistance  
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3199  
(PULSE GENERATORS)  
(Trigger)  
OPTICALLY ISOLATED HIGH-VOLTAGE TRIGGER SYSTEM  
I. Henins and M.S. Kelly  
Los Alamos National Labs, Los Alamos, NM 87545  
The Review Of Scientific Instruments, Vol. 47, No. 2, pp 168-170 (02/1977).

An optically isolated high-voltage trigger system has been built to eliminate ground loop and electromagnetic interference problems in the triggering of a pulsed high-voltage plasma experiment. In this system fast-rising light pulses are generated at the trigger source and transmitted through 20 m long glass fiber optics cables to detectors, which trigger 7-kV pulsers used to drive high-voltage spark gap switches. The 7-kV pulsers are battery powered and may be floated to the potentials existing on the spark gaps. 9 Refs.

Primary Keywords: Optical Isolation; Battery Operation; Long Battery Life; 7 kV Output; 8 ns Rise Time; 5 ns Jitter  
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3228  
(CIRCUIT CALCULATIONS)  
(Capacitance)  
CAPACITANCE CALCULATIONS FOR SOME BASIC HIGH VOLTAGE ELECTRODE CONFIGURATIONS  
P. Maruvada and M. Mylton-cavallius  
Hydro-Quebec Institute of Research, Varennes, Quebec, Canada  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-94, No. 5, pp 1708-1713 (09/1975).

Calculation of the capacitance to ground, as well as of the capacitance between objects of various shapes is a problem occurring frequently in high voltage engineering. Simple methods do not exist, however, for such calculations even in the case of some basic electrode configurations. Although general purpose computer programs may have been developed for most of the configurations, their availability is rather limited, and the data preparation often cumbersome. Accurate computer calculations of the capacitance to ground have been made for a large number of electrode configurations. The results are presented graphically in a normalized form, and should permit a rapid and precise determination of capacitances for most practical electrode arrangements. Furthermore, some simple equations have been developed which permit an approximate, but often sufficiently accurate, evaluation of the capacitances by hand calculations. It is believed that both the accurate graphs and the simple equations would be of great practical value, especially to high voltage engineers. 9 Refs.

Primary Keywords: Sphere; Circular Disc; Horiz. and Vertical Rectangular Plates; Normalized Curves; Charge Distribution Determination  
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3242  
(PULSE GENERATORS)  
(Hard-tube)  
HIGH POWER MODULATOR/REGULATORS FOR NEUTRAL BEAM SOURCES  
J.O. Lawson and A. Deitz  
Princeton University, Princeton, NJ  
Availability: CONF-751125-131  
NTIS

PPPL has recently completed two new Modulator/Regulators for neutral injection sources used on the AIC machine and is constructing four new ones for use with sources on the PFT machine. The AIC modulator uses the well proven 4F35/0302 tetrode as the main switch tube, while the PFT modulators will be using the new but significantly higher powered X-217H tetrodes. Some interesting circuit and manufacturing techniques are discussed.

Primary Keywords: AIC Beams; Neutral Atom Beam Injection; Neutral Atom Beam Injection Power Supplies; Ion Sources; Modulator Switches  
Secondary Keywords: NTIS/EP

3251  
(BREAKDOWN STUDIES; INSULATION; VACUUM)  
(Surface Flashover)  
INSULATOR FLASHOVER MECHANISM IN VACUUM INSULATED CRYOCABLES  
P. Graneau and D.B. Montgomery  
Massachusetts Institute of Technology, Cambridge, MA  
Journal Of Vacuum Science And Technology, Vol. 13, No. 5, pp 1081-1087 (10/1976).

The authors present evidence that surface flashover in vacuum is largely due to gases absorbed at the insulation surface. Cryogenic underground power cables are considered in experiments in the conditioning effect in vacuum insulation, insulation damage experiments, and flashover mechanism investigations. It is shown that the early stages of surface flashover are the results of discharges in the absorbed gases. 11 Refs.

Primary Keywords: Vacuum Insulation; Surface Flashover; Conditioning; Insulator Damage; Lichtenberg Discharge  
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3253  
(BREAKDOWN STUDIES)  
(Electrodes)  
IONIZATION, ELECTRODE SURFACES AND DISCHARGES IN SF<sub>6</sub>/SUB 6/ AT EXTRA-HIGH-VOLTAGES  
C. Conke  
Massachusetts Institute of Technology, Cambridge, MA  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-94, No. 5, pp 1518-1523 (09/1975).

The influence on DC electrical performance of SF<sub>6</sub> gas from small protrusions on electrode surfaces has been investigated experimentally in a system of moderate size over the pressure range from 1/2 to 15 atm abs. The protrusions used were steel or aluminum spheres with 0.075cm radius or a rod 10 times higher than its tip radius of 0.039cm. Over the complete voltage range, 100 kV to 1500 kV, good agreement was found between measured values and those calculated using a simple ionization development model for discharge initiation. This simple model was applied to calculate the effect of other protrusion shapes. In each case when the product of gas pressure times protrusion height above a flat electrode exceeded 80 atm-cm, their presence decreased the breakdown stress. Scanning microscope views of the sphere tips after sparking showed microscopic protrusions which account for the deterioration found after the first spark. 15 Refs.

Primary Keywords: Effects Of Small Protrusions On Electrode Surface; 1/2 To 15 Atm Abs; Spherical Protrusions; 100 Kv To 1500 Kv; Pressure-protrusion Height Product; Scanning Microscope Data; SF<sub>6</sub> Insulated Equipment  
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3258  
(BREAKDOWN STUDIES)  
(Gas; Electrical)  
NANOSECOND VOLUME DISCHARGE IN AIR AT ATMOSPHERIC PRESSURE  
S. Andreev and G. Novikova  
Affiliation Not Given  
Sov. J. Phys. Technical Physics, Vol. 20, No. 8, pp 2078-2084 (08/1976).

Trans. From: Zhurnal Tekhnicheskoi Fiziki, Vol. 45, pp 1692-1703  
In the breakdown of short gaps in air at atmospheric pressure at high over-voltages in electron density reaches 10<sup>16</sup>cm<sup>-3</sup>, and the glow region has clearly defined boundaries in the region of pronounced ionization, which emits a continuum. The line emission forms a packet which gives the glow region a diffuse shape in white light. A model of the nonequilibrium plasma is analyzed; it can be used to calculate the electron temperature and drift velocity. The quasi-steady nature of the current and voltage is attributed to the inertial lag in the gas heating, due to the heat capacity of the gas. Ionization processes are inhomogeneous over the length of the gap. A region with an elevated charged-particle density develops from the cathode toward the anode while there is a quasi-steady voltage between the electrodes. The contraction process, which completes the volume-discharge stage, turns out to be due to an avalanche increase in the electron density as the conditions for equilibrium thermal ionization are approached. 11 Refs.

Primary Keywords: Short Voltage Pulse; Volume Glow; Avalanche Increase In Electron Density; Hemispherical Electrodes; Pointed Electrodes  
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3275  
(PARTICLE BEAMS; ELECTRON; ENERGY STORAGE; INDUCTIVE)  
(Generation; Systems)  
ACCELERATING AND SWITCHING OPTOELECTRONIC SYSTEM OF A HIGH-POWERED ACCELERATOR WITH AN INDUCTIVE STORAGE ELEMENT  
I.M. Sil'kov and G.I. Dolgachev  
Instruments And Experimental Techniques, Vol. 18, No. 3, pp 688-691 (06/1975).

Trans. From: Priroda i Tekhnika Eksperimenta 3, 27-30 (May-June 1975)  
The characteristics and design of an optoelectronic system are considered, which in a high-powered pulsed electron accelerator with an inductive energy storage element, provides current switching and generation of a beam of accelerated electrons. The circuit of an accelerator with this optoelectronic system is described. 5 Refs.

Primary Keywords: E-beam Generation; Inductive Energy Storage; Optoelectronic System; Variable Permeance  
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3286  
(PARTICLE BEAMS; ELECTRON)  
(Generation)  
COLD CATHODE ELECTRON GUNS IN THE LASL HIGH POWER SHORT-PULSE CO/SUB 2/ LASER PROGRAM  
G. Singer, J.S. Ladish and M.J. Nutter  
Los Alamos National Labs, Los Alamos, NM 87545  
Avail. 75-1108-14, 24p (01/1975).  
Availability: LA-UR-75-2355  
NTIS

The design, operation, and performance of the 200 x 35 cm x 2.5 m cold cathode electron gun used in the 2.5 kJ laser system and to be used in the 10 kJ laser are described.

Primary Keywords: Carbon Dioxide Lasers; Electron Beams; Electron Sources; Design; Control Systems; Operation; Performance  
Secondary Keywords: Cold Cathodes; Electron Guns; NTIS/ERDA

3287  
(SWITCHES, CLOSING)  
(Vacuum Gaps, Electrical)  
CONTROLLED VACUUM SPARK GAPS RATED AT A VOLTAGE OF 50 KV FOR MULTIPLE COMMUTATION OF MEGA-AMPERE CURRENTS  
P. N. Dashuk and G. S. Kichanova  
Leningrad Polytechnical Institute, Leningrad, USSR  
Instruments and Experimental Techniques, Vol. 18, No. 2, pp 463-465 (1975).  
Trans. from Priroda i Tekhnika Eksperimenta 2, 113-115 (March-April 1975).  
The construction and the results of an experimental study of vacuum spark gaps suitable for multiple commutation (>5000 "makes") of current pulses having an amplitude of 114 to 1.2E6 A and a length of approximately 1E-3 to 1E-5 sec in capacitive storage devices having an energy of approximately 50 kJ are presented. The time delay of spark gap operation at a pressure of 0.265 Pa and at voltages of 1E5 to 5E6 V is equal to approximately 0.2 microseconds. The mean square deviation does not exceed 20 nsec. The distribution of the time delay corresponds to a normal law. The dielectric strength of the insulation insulation of the spark gaps after multiple commutation of currents having various shapes amounts to 60 and 65 kV. The resistance of the spark gap is 6 mH. 3 Refs.  
Primary Keywords: Vacuum Spark Gap; 50 kV Operating Voltage; 1.2 MA Current; 6 mH Inductance; Delay Measurement; Jitter Measurement; Life Test  
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3302  
(PLASMA GENERATORS)  
(Fast Discharge Machines)  
FUNDAMENTAL LIMITATIONS AND TOPOLOGICAL CONSIDERATIONS FOR FAST DISCHARGE MICROPLASMA MACHINES  
M. D. Briggs, S. A. Neary, M. G. Pulander, W. F. Wilson and H. H. Woodson  
University of Texas at Austin, Austin, TX  
IEEE Transactions On Plasma Science, Vol. PS-3, No. 4, pp 209-215 (1975).  
4 Refs.  
Primary Keywords: Homopolar Machines; Fast Discharge (5-30ms)  
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3306  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
HIGH VOLTAGE STATIC BREAKDOWN IN VACUUM  
A. Watson  
University of Western Ontario, London, Ontario, Canada  
Canadian Journal of Physics, Vol. 54, No. 2, pp 142-157 (01/1976).  
A model of the vacuum breakdown mechanism, where a semiconducting layer on a cathode protrusion produces the prebreakdown current, is presented. An analysis is given of the creation of a virtual cathode and the accompanying electron reservoir, and of the growth of the space charge bubble at the anode. The interaction of the two regions, ion interaction with the electron reservoir, and instabilities in the model are also discussed. The calculated breakdown voltage for copper electrodes is found to agree well with the obtained experimental value. 15 Refs.  
Primary Keywords: Uniform Field Breakdown; Electron Reservoir; Virtual Cathode; Anode Evaporation; Impact Ionization  
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3320  
(BREAKDOWN STUDIES, INSULATION, VACUUM)  
(Vacuum, Particle)  
IN-SITU OBSERVATION OF MICROPARTICLES IN A VACUUM-INSULATED GAP USING A SCANNING ELECTRON MICROSCOPE  
G. D. Theophilus, K. D. Srivastava and R. G. Van Heeswijk  
University of Waterloo, Waterloo, Ontario, Canada  
Journal of Applied Physics, Vol. 47, No. 3, pp 897-898 (03/1976).  
Results are presented of an investigation into microparticle activity in a vacuum-insulated 1-mm electrode gap. The experiments were conducted in situ in the specimen state of a scanning electron microscope (SEM) and confirm microparticle activity at voltages well below breakdown. The most common size of the microparticles observed was 3 micrometers and very few particles above 10 micrometers were detected. 6 Refs.  
Primary Keywords: Small-sized Microparticle; Medium Sized Microparticle; Large Microparticle; Microparticle Activity; Insulator Charging  
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3322  
(SWITCHES, CLOSING)  
(Vacuum Gaps, Optics)  
LASER-TRIGGERED VACUUM SWITCH  
V. S. Bulvaev, V. E. Lebedev, G. A. Pryanikova, V. V. Ryukert, S. S. Tsiklashvili and V. A. Yakovlev  
Soviet Physics Technical Physics, Vol. 20, No. 4, pp 561-563 (04/1975).  
Trans. from Zhurnal Tekhnicheskoy Fiziki 45, 892-897 (April 1975).  
The conductivity of a two-electrode vacuum gap is increased by the plasma produced by focusing laser light on the surface of one of the electrodes. The switching properties of a vacuum discharge initiated by the laser beam are determined. These studies are conducted over a wide range of gap voltages and for differing polarities of the target electrode. 3 Refs.  
Primary Keywords: Vacuum Spark Gap; Electrode Laser Illumination; Surface Triggering; Delay Measurement; Jitter Measurement  
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3328  
(PARTICLE BEAMS, ION)  
(Sorption)  
PLASMA-SURFACE SOURCE OF NEGATIVE IONS  
L. I. Belitskiy, G. I. Dimov and V. G. Rudnikov  
Institute of Nuclear Physics, Academy of Sciences of the USSR, Novosibirsk, USSR  
Soviet Physics Technical Physics, Vol. 20, No. 3, pp 47-49 (07/1975).  
Trans. from Zhurnal Tekhnicheskoy Fiziki 45, 68-73 (January 1975).  
A high-power pulsed source of negative ions that uses a plasmotron discharge is described. A H beam with a current density up to 1.7 A/cm<sup>2</sup> on the emission slit has been obtained from the discharge chamber as a result of the interaction of negative ions from the cathode surface, which is bombarded by fast particles from the discharge. The intensity of the extracted ion beam is roughly proportional to the area of the emission slit. A negative ion beam with a current of 0.8 A has been obtained from a source with an extraction voltage of 5 kV. A 10 mA ion beam current is less than 200 nA. 6 Refs.  
Primary Keywords: Hydrogen Ion; Plasmotron Discharge; 1 A Ion Current; Cathode Bombardment; Ry. Electrons  
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3340  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
PREBREAKDOWN PHENOMENA IN VACUUM WITH DIRECT AND ALTERNATING VOLTAGES AT ROOM AND CRYOGENIC TEMPERATURES  
P. N. Allan and P. K. Bardoloi  
University of Manchester, Manchester, UK  
Journal of Physics D: Applied Physics, Vol. 8, No. 15, pp 2170-2180 (12/1975).  
These investigations were conducted to measure the prebreakdown current and breakdown voltage between stainless steel electrodes using 50 Hz alternating and direct voltages. The measurements were made at room temperature and liquid nitrogen temperature using uniform field electrodes. The range of electrode spacings for the current measurements was 0.1-2.1 mm and for the breakdown voltages was 0.1-0.8 mm. The variation of the prebreakdown current and breakdown voltage with temperature and electrode spacing was very similar with both types of voltage. At room temperature, with both types of voltage, the prebreakdown current obeyed a cold-cathode emission law, analytically similar to the Fowler-Nordheim relation. In both cases an ambient pressure greater than about 1E-6 Torr caused the current to be depressed, though this was found to be a reversible effect. 18 Refs.  
Primary Keywords: Prebreakdown Current; Breakdown Voltage; Power Line Frequency; DC Voltage; Room Temperature; Liquid Nitrogen Temperature  
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3352  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
ELECTRICAL BREAKDOWN OF LONG GAPS IN SULFUR HEXAFLUORIDE  
T. Nitta and Y. Shioyama  
Mitsubishi Electric Corp., Amagasaki, Japan  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-90, No. 3, pp 1045-1051 (06/1971).  
The electrical discharge characteristics of SF<sub>6</sub>/sub 6/ are discussed theoretically in relation to the field dependence of the ionization coefficient, alpha, and the electron attachment coefficient, eta. The results are compared with the characteristics of air. A simple theoretical formulation of breakdown or corona inception voltages of gaps in SF<sub>6</sub>/sub 6/ is derived. The formulation has been examined by experiments on several electrode configurations. At low pressures of less than 4 atm, the agreement of the theoretical and the experimental results is fairly good. The breakdown voltage decreases from the theoretical estimation at higher pressure. 12 Refs.  
Primary Keywords: SF<sub>6</sub>/sub 6/; Theory; Breakdown; Corona; Analytical Solution; Ionization Coefficient; Attachment Coefficient; High Pressure; Comparison With Air  
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3362  
(SWITCHES, CLOSING)  
(Liquid Gaps, Self)  
WATER SPARK GAP FOR A NITROGEN LASER  
S. Saiken and F. Shimizu  
University of Tokyo, Bunkyo-ku, Tokyo, Japan  
Review Of Scientific Instruments, Vol. 46, No. 12, pp 1700-1701 (12/1975).  
Satisfactory operation of the Blumlein type nitrogen laser was obtained by using a water-filled spark gap. The water-filled spark gap uses flowing water, and the Blumlein circuit is charged by a Marx-bank driver. 4 Refs.  
Primary Keywords: Water Spark Gap; Blumlein Line; Fast Rise Time; Comparison With Air Gap; General Electrode Material  
Secondary Keywords: Gas Laser; Pumping  
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3374  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
FAST AIR GAP CROWBAR SWITCH DECOUPLED BY A LOW PRESSURE GAP  
S. Kitagawa and K. I. Hirano  
Nagoya University, Nagoya, Japan  
Me JPRP-20, 26p (04/1974).  
Availability: NTIS-35138/MS1  
N115  
A fast pressurized crowbar gap switch, in which a low pressure gap is used as a nonlinear decoupler, is investigated. The switch is composed of a single two-electrode high pressure gap and a low pressure gap of triatron type. A special trigger circuit is designed in order that a single pulse breaks down the high- and low-pressure gaps successively. The jitter of breakdown time is less than 20 nsec over the wide range of the operating conditions: working voltage and pressure in both gaps. The switch is designed for 40 kV operation and its inductance is 22 nH. Seventy switches of this type are installed in a 40 kV, 210 kJ fast capacitor bank. Up to now they have been running successfully for 8000 shots with little maintenance. (Author)  
Primary Keywords: Gaps; High Voltages; Switches; Trigger Circuits; Capacitors; Electric Switches; Plasma Pinch; Tristatrons  
Secondary Keywords: NTISNAGA

3383  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES)  
(Electronics; Gas; Electrical)  
INVESTIGATION OF ELECTRODE EROSION AND OF THE CONDITIONS OF SPECTRUM EXCITATION WITH AN IMPULSIVE DISCHARGE IN A MAGNETIC FIELD  
A. V. Kolesnikov, L. A. Strulov and A. A. Yunkovskiy  
Journal Of Applied Spectroscopy, Vol. 19, No. 2, pp 969-973 (08/1973).  
Trans. From: Zhurnal Prikladnoy Spektroskopii, 19, 195-201 (August 1973).  
Previous research investigated the entrance of electrode material into the cloud of a low-voltage impulsive discharge and established the time variation of the entrance of both the vapor and liquid phases of the erosion products. In the initial stage of the discharge, independently of the electrode's polarity, there was a predominant entrance of material in the most finely divided phase. The duration of this discharge stage was increased by mechanical displacement of a substitute electrode along into flat surface of the electrode. This permitted an enhancement of effectiveness in the use of material for containing a spectrum. In the present research, instead of mechanical displacement of a substitute electrode, the base of the discharge's current-conducting channel was displaced under the action of a magnetic field. The coil that created the magnetic field had an inductance of 20 microHenry and was connected into the discharge circuit in series with the interelectrode gap. Fine scanning of the total discharge-cloud luminescence showed that brightly shining spots adjacent to an electrode are formed on the surface of the space men during the discharge. In the initial stage of the discharge, the shifting of the spots is smooth and continuous, with increase of current the spots shift in a jerky manner. The number of such spots is larger than that of the cathode spots. 2 Refs.

Primary Keywords: Gas Breakdown; Low Pressure Breakdown; Electrode Erosion; Magnetic Field; Electrode Spot Movement; Arc Spot; Cathode Spot.  
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3385  
(LASER TRIGGERED SWITCHING OF A PULSED, CHARGED, OIL FILLED SPARK GAP)  
A. C. Kline, G. L. Ziegler, L. R. Zettin and R. P. Connelord  
Review Of Scientific Instruments, Vol. 46, No. 7, pp 914-920 (07/1975).  
A technique, based on laser alignment along the interelectrode axis of a spark gap, has been developed. This technique was used to initiate the discharge of an oil-filled spark gap. The oil-filled spark gap was operated at 200 kV and the voltage pulse exhibited a rise time of 100 nsec to a voltage of 100 kV. A parametric study of the factors affecting the delay between the laser pulse arrival at the gap and conduction of the gap was accomplished, in which the effects of the focal point location, laser power, switch polarity, and voltage on the gap at laser arrival were determined. Delay times as short as 12 nsec were recorded with jitter, a measure of reproducibility, in the low nanosecond region. 13 Refs.  
Primary Keywords: Laser Switching; Pulse Charged Dielectrics; Oil Dielectrics; Laser Triggered Marx Generator; Oil-filled Capacitors; Laser Induced Breakdown; Arc Discharge; Nanosecond Switching.  
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3390  
(BREAKDOWN STUDIES)  
(Gas; Electrical)  
ON THE THEORY OF THE SPARK PLASMA IN NANOSECOND LIGHT SOURCES AND FAST SPARK-GAP SWITCHES  
H. Kess  
Akademie der Wissenschaften der DDR, Zentralinstitut für Elektronenphysik, Berlin, DDR  
Journal Of Physics D: Applied Physics, Vol. 8, No. 6, pp 685-689 (04/1975).  
In papers on nanosecond gas discharge light sources there has been no theoretical description of the dependence of the half-width and the maximum power of the optical pulse on the many parameters which can be varied. On the basis of the theory of Weizel and Rompe (1947) extended to thermal plasmas, the author predicts at least the electric behaviour of the spark discharge in low-inductance circuits normally used for the generation of nanosecond light pulses. 15 Refs.  
Primary Keywords: Spark Discharge; Theory; Thermal Plasma; Power Dissipated.  
Secondary Keywords: Optical Source.  
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3434  
(SWITCHES, CLOSING)  
(Gas Gaps; Optical)  
APPLICATIONS OF A LASER-TRIGGERED SPARK GAP (LTSG)  
T. Naguchi (1), M. Yano (2), T. Tsuruta (2), and K. Horii (2)  
(1) Electrotechnical Lab, Tokyo, Japan  
(2) Nagoya University, Nagoya, Japan  
Electrical Engineering In Japan, Vol. 94, No. 2, pp 13-19 (03/1974).  
Trans. From: Denki Gakkaishi Ronbunshu, 94, 121-128 (March 1974).  
20 Refs.  
Primary Keywords: Applications; Several Triggering Modes; Crowbar Switch; Master Trigger Gas.

3438  
(PARTICLE BEAMS, ELECTRON; PARTICLE BEAMS, ELECTRON)  
(Transport; Target Interactions)  
ELECTRON BEAM FOCUSING AND APPLICATION TO PULSED FUSION  
G. Yones, J. W. Poukey, K. R. Prestwich, J. R. Freeman, A. J. Toepfer and M. J. Clauser  
Sandia Labs, Albuquerque, NM 87115  
Nuclear Fusion, Vol. 14, No. 3, pp 31, 74 (01/1974).  
Recent works on the focusing of high-current relativistic electron beams are reviewed and the physics of these beams is examined both empirically and through computer simulation. The application of the electron beams to fusion research is discussed along with the interaction of the beam with the target and the beam requirements for fusion. 49 Refs.  
Primary Keywords: Relativistic Electron Beam; Beam Focusing; Vacuum Diode; Plasma Transport.  
Secondary Keywords: Inertial Confinement Fusion.  
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3423  
(POWER CONDITIONING)  
(Pulse Transformers)  
FOCUS ON PULSE TRANSFORMERS  
Unknown  
Electronic Design, Vol. 23, No. 13, pp 78-83 (04/1975).  
A discussion of pulse transformers and their key parameters is given. Problems and tradeoffs in designing systems with pulse transformers are examined with a special emphasis given to reading and interpretation sheets. 0 Refs.  
Primary Keywords: Characterization; Reading Specifications; Application Data; Design Considerations; Bibliography Of Supplies.  
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3424  
(BREAKDOWN STUDIES)  
(Plasma)  
GAS LASER DISCHARGES IN CONTINUOUS METAL TUBES  
A. L. S. Smith and M. Brooks  
University of St. Andrews, St. Andrews, Fife, KY16 9SS, UK  
Journal Of Physics D: Applied Physics, Vol. 7, No. 16, pp 2455-2463 (12/1974).  
4 Refs.  
Primary Keywords: Current Distribution; Multi Segment Construction; Glow Discharge; Simple Continuous Discharge; 10 Torr; CO<sub>2</sub> Sub 20 Laser.  
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3429  
(PULSE GENERATORS)  
(Trigger)  
HIGH-SPEED SWITCH HANDLES 400V 400-HZ PEAK AND IS CONTROLLED BY LOGIC LEVELS  
S. D. Anderson  
Minneapolis, MN 55417  
Electronic Design, Vol. 23, No. 2, pp 74 (01/1975).  
A circuit is presented that can switch 450 V at 100 kHz. Output voltage waveforms are given for switching rates of 1 kHz and 100 kHz (310 V into a 10 k ohm load). 0 Refs.  
Primary Keywords: 400 V Voltage Range; Very High Rate; Fast Rise; Isolated Switch.  
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3452  
(BREAKDOWN STUDIES)  
(Electrodes)  
INFLUENCE OF ELECTRODE COATINGS ON THE BREAKDOWN STRENGTH OF TRANSFORMER OIL  
A. A. Zaky, M. E. Zain Eldine and R. Hawley  
C. A. Parsons & Co Ltd, Newcastle-upon-Tyne, UK  
Nature, Vol. 202, pp 687-688 (05/1964).  
The influence of coating one or both of the electrodes on the breakdown of transformer oil is studied. It is found that coating the electrodes with 'Penton' increases the initial breakdown voltage substantially. Coating either electrode is found to be as effective as coating both electrodes. 4 Refs.  
Primary Keywords: Transformer Oil Breakdown; Electrode Coating; 'Penton'; One Electrode Coated; Both Electrodes Coated.  
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3462  
(MAGNETIC INSULATION)  
(Coaxial High-Voltage Diode With Magnetic Insulation)  
V. S. Voronin and A. N. Lebedev  
Academy of Sciences of the USSR, Moscow, USSR  
Soviet Physics Technical Physics, Vol. 18, No. 12, pp 162-1631 (06/1974).  
Trans. From: Zhurnal Tekhnicheskoy Fiziki, Vol. 43, pp 2591-2598 (1974).  
A theory is derived for magnetic insulation in a relativistic coaxial diode. This theory is self-consistent in terms of the magnetic field (both diamagnetism and the electrostatic field (space-charge limitation). The magnitude of the insulating magnetic field is found as a function of the diode parameters. The self-consistent equilibrium of a charged hollow beam in an external magnetic field is analyzed in the transport section. The conditions corresponding to maximum current are determined. 5 Refs.  
Primary Keywords: Relativistic Coaxial Diode; Diamagnetism; Space-charge Limitation.  
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3483  
(INSULATION, VACUUM)  
(High-Voltage Vacuum Insulation With Epoxy-Coated Cathodes)  
J. Jedyński (1) and S. Y. Towlati (2)  
(1) University of Wisconsin, Madison, WI  
(2) University of Tehran, Iran  
Journal Of Vacuum Science And Technology, Vol. 11, No. 1, pp 472-473 (02/1974).  
The breakdown voltages for two electrode coating materials (C-26 epoxy and M-12/sulphur) and uncoated electrodes in vacuum are compared for several gap spacings, ranging from 1.4 mm. The authors conclude that the breakdown voltage is dependent only on field strength and that the coatings have a significant effect on breakdown voltage and peak electron currents. 5 Refs.  
Primary Keywords: Vacuum Insulation; Epoxy Coating; Breakdown Voltage; Breakdown Current; Variable Gap Spacing.  
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Primary Records: Gas Breakdown; Uniform Field; SF/sub 6/; Field Nonuniformities; Prebreakdown Current; Ionization Coefficient; Attachment Coefficient; Theory

Primary Keywords: Point To Plane Gap; Critical Charge Criterion  
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Primary Keywords: Ionizing Radiation; Conduction; Charge Transfer;  
Space Charge; Numerical Calculation  
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Primary Records: Air Gap; Rod-rod Gap; Rod-plane Gap; Impulse Voltage; 7-27 g/cu.m. Humidity; Linear Relationship

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**Secondary Keywords:** Energy Conversion; Electrolysis; Electric Arcs; Generators; Electrolytes; Bubbles; Electric Arcs; Boiling; Electrical Resistance; High Energy; High Power; Thyristors

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Considerations. Analysis. Step Response  
COPYRIGHT. 1953 IEEE, REPRINTED WITH PERMISSION

Primary Keywords: Corona, Breakdown; Coaxial Line; DC Voltage; AC Voltage; Beta Particles; Improved Breakdown Voltage

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3587  
(BREAKDOWN STUDIES; SWITCHES; CLOSING)  
(Gas; Electrical; Gas Gaps; Optics)  
INFLUENCE OF ILLUMINATION ON THE SPARKOVER OF SPHERE GAPS AND  
CROSS-SECTIONAL GAPS STRESSED WITH IMPULSE VOLTAGES  
T. A. Allibone and D. D. Dilling  
Leeds University, Leeds, UK  
Proceedings of IEE, Pt. 120, No. 7, pp 815-821 (07/1973).  
The authors consider the effects of illumination of sphere-sphere  
gaps on breakdown characteristics. The effect of voltage polarity,  
pulse duration, sphere diameter and gap spacing are studied with and  
without incident UV and gamma radiation to determine its effect. The  
main feature of the experiment is to determine the desirability of  
incorporating spark gaps to be used as voltage monitors. There are,  
however, several aspects of the experiment that would be useful to  
engineers of spark gaps as well as to 15 Refs.  
Primary Keywords: Spark Gaps; UV Irradiation; Gamma  
Irradiation; Variable Diameter; Variable Spacing;  
Variable Polarity; Breakdown Characteristics

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3588  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES)  
(Electrical; Vacuum)  
LIGHTEMBERG FIGURES PRODUCED BY HIGH-VOLTAGE DISCHARGES IN VACUUM  
P. G. G. G. G.  
Department of Electrical Engineering, Cambridge, MA  
IEEE Transactions On Electrical Insulation, Vol. EI-8, No. 3, pp 87-91  
(03/1973).  
The formation of Lichtenberg figures on aluminum and titanium  
electrodes covered by oxide and nitride layers while being exposed to  
high vacuum and 100-kV (rms) 60-Hz voltage is recorded. The  
observations were made in the course of research on high-voltage  
vacuum insulation for cryostats. The Lichtenberg figures have  
several technological implications. They provide evidence for the  
occurrence of 1) forced ion beams, and 2) tangent air discharges in  
the adsorbed layer of gas on the vacuum side of dielectric coverings  
on metal conductors. As Lichtenberg figures can only be produced by  
fast high-voltage pulses, they prove that the discharge duration was  
short compared with the period of the 60-Hz voltage wave. 7 Refs.  
Primary Keywords: Lichtenberg Figures; Aluminum Electrodes; Titanium  
Electrodes; High Voltage Pulse; Fast Pulse

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3596  
(BREAKDOWN STUDIES)  
(Vacuum; Materials)  
MODEL DESIGN FOR ACCURATE ALIGNMENT OF HIGH VOLTAGE ELECTRODES ASSEMBLY  
R. Packman and S. K. Salmon  
University of Sheffield, Sheffield, UK  
Vacuum, Vol. 23, No. 1, pp 9-10 (01/1973).  
A design is described which enables the accurate alignment of high  
voltage plane parallel electrodes used in an ultra-high vacuum  
assembly. The main features of this design are that it effectively  
overcomes the eccentricities which are present in both the  
glass-to-metal graded seal used in the housing envelope and in the  
linear motion drives employed to vary the gap separation between the  
electrodes, as well as being relatively simple to fabricate. The  
present design has been successfully tested in two large chambers at  
applied voltages of up to 100 kV and at a background pressure of  
better than  $10^{-9}$  Torr. 0 Refs.  
Primary Keywords: Electrode Alignment; Parallel plane Electrodes;  
Electrode Positioning; Breakdown Chamber Design

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3604  
(BREAKDOWN STUDIES; SWITCHES; CLOSING)  
(Gas; Optical)  
TRIGGERING MECHANISM OF A LASER-TRIGGERED SPARK GAP  
T. Naguchi (1), M. Yano (1), T. Shimomura (1) and K. Horii (2)  
(1) Electrotechnical Lab., Tokyo, Japan  
(2) Nagoya University, Nagoya, Japan  
Electrical Engineering in Japan, Vol. 92-A, No. 5, pp 27-34 (10/1972).  
Trans. From: Denki Gakkaishi, 92A, 449-456 (October 1972).  
There has been an urgent need to develop impulse voltage and large  
current generators with fast rise time for use in the field of  
nuclear fusion, and which facilitates the development of high-speed  
switches. We have investigated the triggering mechanism of the  
laser-triggered spark gap (LTSG) for use as a high-speed switch. The  
LTSG is a switch which initiates the breakdown of the gap by  
generating a laser spark in the gap with an applied voltage lower  
than the self-breakdown voltage. 18 Refs.  
Primary Keywords: Breakdown Mechanism; High Energy Concentration;  
Deflection Wave; Double Current Pulse; Delay

3607  
(TRANSMISSION)  
(Cables)  
ADVANCED APPLICATION REPORT: HIGH VOLTAGE V.P.E. INSULATED POWER CABLE  
WITH SEMI-CONDUCTING ORGANIC LIQUID  
T. Shibata, H. Matsuda, K. Nakano and T. Tanabe  
The Furukawa Electric Co. Ltd., Tokyo, Japan  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-91, No. 5,  
pp 1931-1940 (10/1972).  
In our previous paper we reported our fundamental study and, to  
some extent, application to cables of the semiconducting organic  
liquid which, when mixed in cross-linked polyethylene insulation for  
cable, deposits on the surfaces of voids in the insulation or between  
the insulation and the semiconducting layer with the lapse of time  
and brings about a permanent reduction in surface resistivity. From  
this we were able to explain the fact that the cable with self-healing  
partial discharges. Furthermore, its voltage-time characteristics  
curve of the cable with such insulation is more horizontal as  
compared with that of conventional cross-linked polyethylene insulated  
cable. We have now confirmed our study on such semiconducting  
organic liquid in the process of its application to cable insulation.  
and therefore is stable with very little movement. The cable  
insulation containing the semiconducting organic liquid has a higher  
impulse breakdown voltage and is free from breakdown at low voltages.  
We also found that its AC voltage breakdown voltage is not too far  
but to thermal breakdown caused by sharp increase in the temperature  
near the breakdown voltage. 9 Refs.  
Primary Keywords: Cable Insulation; Semiconducting Organic Liquid;  
Voltage; Field Strength; Partial Discharge; Breakdown

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3609  
(BREAKDOWN STUDIES)  
(Gas; Electrical)  
BREAKDOWN CHARACTERISTICS OF HIGHLY NON-UNIFORM LONG GAPS IN COMPRESSED  
AIR  
T. Takuma, T. Motenobu and K. Kito  
Central Research Institute of the Electric Power Industry, Tokyo, Japan  
Proceedings of The IEE, Vol. 119, No. 12, pp 1767-1768 (12/1972).  
The authors present data on the breakdown voltage of long (50 cm)  
compressed air gaps. A rod-plane geometry is used with a square rod  
utilized. Both polarities are considered with a range of pressures  
and gap spacings used. Both breakdown voltage and delay data are  
presented. 0 Refs.  
Primary Keywords: Compressed Air Gaps; 50 cm Gaps; Rod-plane Gaps; Square  
Rod; Corona; Breakdown Path

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3615  
(PULSE GENERATORS)  
(Trigger)  
DOUBLING BREAKDOWN VOLTAGE WITH CASCODE TRANSISTORS  
P. T. Under  
Tinker Air Force Base, Midway City, CA  
Electronics, Vol. 46, No. 1, pp 102 (01/1973).

A method of protecting bipolar transistors when placed in series  
in power-circuit applications is discussed. The breakdown voltage of  
the transistors is doubled without the use of costly high-voltage  
generators by tying a cascode switch across each. 2 Refs.  
Primary Keywords: Saturating Cascode Switch; Transistor Saturator;  
Charge-storage Transient Suppression

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3617  
(BREAKDOWN STUDIES)  
(Gas; Electrical)  
ELECTRICAL BREAKDOWN AND THE SIMILARITY LAW IN SF/SUB 6/ AT  
EXTRA-HIGH-VOLTAGES  
I. M. Borzhik (1) and C. M. Cook (2)

(1) All-Union Institute, Moscow, USSR  
(2) Massachusetts Institute of Technology, Cambridge, MA  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-91, No. 5,  
pp 2186-2203 (10/1972).  
The DC electrical breakdown of SF/sub 6/ gas at  
extra-high-voltages was studied experimentally in coaxial systems of  
moderate size. The results were compared to a similarity relationship  
of electric stress for breakdown based on ionization of the gas. For  
laboratory-scale systems, theory and experiment agree when the  
macroscopic gradient does not exceed 150 to 200 kV/cm. If the active  
area of the stressed electrode is small the law remains accurate for  
higher gradients. Departures from the law are qualitatively explained  
by including the electrode surface microstructure in its application.  
20 Refs.

Primary Keywords: SF/sub 6/; DC Breakdown; In Sulfurhexafluoride;  
Coaxial System; Similarity Law; Experiment; Theory;  
Electrode Surface Structure

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3623  
(INSULATION; VACUUM)  
(1) HIGH-VOLTAGE CONDITIONING AT LARGE GAPS IN INDUSTRIAL VACUUM  
G. F. Steib (1) and F. Moll (2)  
(1) CEA Centre d'Etudes Nucleaires, Saclay, France 92260  
(2) Institut Max von Laue-Paul Langevin, France  
Journal Of Physics D: Applied Physics, Vol. 6, No. 2, pp 243-255  
(01/1973).

The improvement of high-voltage insulation in vacuum by ageing the  
electrodes is well known. This so-called conditioning effect becomes  
very important if ultra-high-vacuum techniques cannot be employed in  
systems with large dimensions. For unbacked surfaces this effect  
allows one to increase the initial field strength by a factor of  
about 10. In the present paper, the electrode gaps were variable  
between 15 and 30 cm. For such gaps, the conditioning and also the  
deconditioning process which occurs when the high voltage is removed  
have been studied. An attempt has been made to describe these  
processes mathematically, and to understand the mechanism involved.  
The results are compatible with the hypothesis that these effects are  
due to a change in the adsorbed gas layer that is, a change in the  
work function of the electrode material. 26 Refs.  
Primary Keywords: Vacuum Insulation; Conditioning; Breakdown Voltage  
Increase; Deconditioning; Experiment; Theory;  
Ageing

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3625  
(BREAKDOWN STUDIES)  
(Gas; Electrical)  
IMPULSE BREAKDOWN OF LARGE SPHERE-PLANE GAPS  
J. K. Harwood, R. C. Kiew and B. A. Jozar  
Marconi Engineering Lab., Southampton, UK  
Proceedings of The IEE, Vol. 119, No. 12, pp 1751-1753 (12/1972).  
The authors present a comparison of sphere-plane and rod-plane  
long air gaps. Sphere diameters of 25-75 cm, a 12 mm square cut  
rod, and gap distances of 75 to 120 cm place these gaps in the region  
between the uniform field gaps and highly divergent field gaps  
usually studied. Plots of current vs time are presented for several  
gap parameters. 5 Refs.  
Primary Keywords: Long Air Gaps; Sphere-plane Gaps; Rod-plane Gaps; Air  
Gaps; Temporal Current Resolution

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3633  
(BREAKDOWN STUDIES)  
(Gas; Electrical)  
MEASUREMENT OF THE ENERGY RELEASED IN NANSECONDE ELECTRIC SPARKS  
J. Johansson, K. Strid and S. R. Johansson  
Svensk Match Co., Jönköping, Sweden  
Combustion Science And Technology, Vol. 5, pp 1-6 (01/1972).  
The energy released in a spark is studied by the authors. A pulse  
traveling down a transmission line is used to initiate a spark. The  
energy reflected back down the transmission line is analyzed to infer  
the energy dissipated in the spark. A method of calculating the  
energy dissipated without resorting to calculating instantaneous  
power is presented. 4 Refs.  
Primary Keywords: Spark Breakdown; Energy Dissipated; Transmission  
Line; Reflected Energy; Analytical Calculation

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3633  
(INSULATION, MATERIAL)  
(Solid)  
MECHANISM OF SURFACE CHARGING OF HIGH-VOLTAGE INSULATORS IN VACUUM  
C.M. De Tourneil and K.D. Srivastava  
University of Waterloo, Waterloo, Ontario, Canada  
IEEE Transactions On Electrical Insulation, Vol. EI-8, No. 1, pp 17-21  
(03/1973).  
In vacuum, the surface of insulators becomes electrically charged when subjected to high-voltage stresses. The charging mechanism is described. A model simulating the charging shows that the surface charge densities are proportional to the applied voltage and depend on the secondary electron emission of the dielectric surface. It is also time dependent. Surface charges are shown to explain many results obtained in studies of insulator surface breakdown. 10 Refs.  
Primary Keywords: Insulator Charging; Secondary Emission; Incidence Angle; Simulation; Numerical Calculation  
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3634  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
NANOSECOND BREAKDOWN IN HEXANE  
J.A. Bell, P.R. Rogers and A.H. Guenther  
AFML, Kirtland AFB, NM 87117  
IEEE Transactions On Electrical Insulation, Vol. EI-7, No. 2, pp 78-83  
(06/1972).  
The electrical breakdown of hexane was investigated using nanosecond duration high-voltage pulses. An attempt was made to experimentally isolate the formative time lag contributions of the two major breakdown mechanisms: electron avalanche and streamer processes. The electrode area was kept constant at 2.85 sq.cm. throughout the study, and time resolution was on the order of 0.5 ns. The gap spacing and the applied field were varied in a highly controlled manner. A series of breakdown events were studied for gap spacing ranging from 0.07 to 0.41 cm with selected constant field strengths from 0.8 to 1.6 MV/cm. The results obtained indicate that the streamer mechanism is the dominant process in the breakdown of hexane and the average velocity of propagation is on the order of 1E7 cm/s for the fields and gap spacings used in this study. 20 Refs.  
Primary Keywords: Formative Time Lag; Avalanche; Streamer; Very High Field Strength  
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3636  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
OPTICAL KERR CONSTANT MEASUREMENT IN SOME LIQUIDS AND GLASSES  
B. Lacour and J.P. Pocholle  
Centre de Recherches, Compagnie Generale d'Electricite, Marcoussis, France  
IEEE Journal Of Quantum Electronics, Vol. QE-8, No. 5, pp 456-457  
(05/1972).  
We have measured the optical Kerr constant of two glasses and two liquids, namely phosphoryl chloride and toluene. We find that the nonlinear indices  $n_2$  are of the same order of magnitude in glass and phosphoryl chloride. 7 Refs.  
Primary Keywords: Kerr Constant; Phosphoryl Chloride; Toluene; Two Glasses; Glass Laser; 45 Deg. Incident Polarization  
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3638  
(BREAKDOWN STUDIES)  
(Liquid, Electrical)  
PREBREAKDOWN PROCESSES IN ELECTRICALLY STRESSED INSULATING LIQUIDS  
B. Singh, W.G. Chadband, C.W. Smith and J.M. Calderwood  
University of Salford, Salford, UK  
Journal Of Physics D: Applied Physics, Vol. 5, No. 8, pp 1457-1464  
(08/1972).  
It has previously been reported that a spray originates from high-voltage point electrodes in n-hexane. This paper is concerned with more detailed investigation of that spray. Although it is more readily observed if the point electrode is negative, it can also be seen when the point is positive provided that the gap length is adequate. The distribution of spray in the gap of a point-plane system is approximately conical. The apex of the cone is about 60 Deg. for a negative point and 120 deg. for a positive point. The spray appears to consist of bubbles which cross the gap with a velocity of the order of metres per second, and which have grown to become about 15 microns in diameter by the time they reach the plane electrode. Their size at the point electrode is not directly measurable but has been found to be an order of magnitude less by light-scattering measurements. The onset of the spray coincides with the appearance of corona at the tip of the point electrode, and the spray onset voltage is a function of the radius of the electrode tip. An account is given of some of the complex processes which seem to govern breakdown processes in insulating liquids. 23 Refs.  
Primary Keywords: Prebreakdown Current; N-hexane; Point Electrode; N-hexane Spray; Cathode; Corona  
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3639  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
PRECISION CAPACITIVE VOLTAGE DIVIDER FOR IMPULSE VOLTAGE MEASUREMENTS  
A.J. Schwebb and J.H.W. Pagel  
University of Karlsruhe, Karlsruhe, FRG  
IEEE Transactions On Power Apparatus And Systems, Vol. 91, No. 6, pp 2376-2382 (12/1972).  
This paper describes a precision capacitive voltage divider for impulse voltage measurements. The main features of the new divider is a compressed gas capacitor in the high-voltage arm. The divider is insensitive to environmental influences, possesses outstanding high-frequency properties, and causes little loading of the high-voltage circuit. Its excellent linearity and stable ratio permit meaningful high-voltage pulse measurements in the megavolt range. 14 Refs.  
Primary Keywords: Capacitive Voltage Divider; Compressed Gas Capacitor; Good Linearity; Megavolt Voltages  
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3641  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
RECENT REFINEMENTS AND DEVELOPMENTS IN KERR SYSTEM ELECTRICAL MEASUREMENT TECHNIQUES  
E.C. Cassidy (1), W.E. Anderson (1) and S.R. Booker (2)  
(1) National Bureau of Standards, Washington, DC 20234  
(2) Sandia Labs, Albuquerque, NM 87115  
IEEE Transactions On Instrumentation And Measurement, Vol. IM-21, No. 4, pp 504-510 (11/1972).  
Kerr system electrical measurement techniques are improved by progress in two important areas: 1) in the development of methods for visualizing and measuring pulsed (microsecond) electric fields and high voltages from time-varying electrooptical fringe patterns recorded using high-speed photographic techniques, and 2) in the development of convenient experimental methods for evaluating and correcting path-dependent errors in Kerr system response. Results demonstrate use of fringe-pattern measurements in achieving accurate pulse voltage measurements and in correction of errors resulting from sizeable end-field variations in existing 300-kV Kerr cells. 4 Refs.  
Primary Keywords: Kerr Effect; Electric Field Measurement; Error Analysis; Error Correction; Streak Camera  
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3644  
(SWITCHES, CLOSING; SWITCHES, CLOSING)  
(Gas Gaps, Electrical; Gas Gaps, Self)  
SPARK GAPS CAN SWITCH AS WELL AS PROTECT  
M. Distefano  
General Instrument Corp. Neptune, NJ  
Electronics, Vol. 45, No. 15, pp 94-95 (07/1972).  
Possible applications of the spark gap as a high-energy, voltage-sensitive switch are discussed. Considered are load protection circuits, flash tube triggering circuits, crowbar protection circuits, and high-voltage Marx generators. Important parameters and characteristics of the spark gap are examined. 0 Refs.  
Primary Keywords: Low Voltage; Arc Mode; Short Duty; Triggered Spark Gap; Self-breaking Spark Gap  
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3646  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
SPECIAL SPARK-GAP SWITCHES FOR USE IN SYNTHETIC TEST CIRCUITS  
N.S. Ellis, W.T. Lughton, C.W. Powell and H.M. Ryan  
A. Rayrolle & Co. Ltd., Habburn, County Durham, UK  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-91, No. 5, pp 2020-2025 (10/1972).  
In technology concerned with proving the performance of modern high-power circuit-breakers, special spark-gap switches have been developed to meet the specific requirements of 'break' and 'make-break' synthetic circuits, the former operating up to equivalent three-phase test levels of 30 G.V.A. This paper describes the design, performance characteristics and operating experience for two types of specialized triggered switches incorporated in the Synthetic test circuits of the Rayrolle Short-Circuit Testing Station. 6 Refs.  
Primary Keywords: Plasma-jet Trigger; Spinner Electrode Switch; Large Voltage Range; High Reliability; Air Blast Gaps  
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3647  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
SUBNANOSECOND HIGH VOLTAGE ATTENUATOR  
H.D. Sutphin  
Los Alamos National Labs, Los Alamos, NM 87545  
Review Of Scientific Instruments, Vol. 43, No. 10, pp 1535-1536  
(10/1972).  
A high voltage attenuator has been developed and tested that is capable of maintaining pulse rise times of less than 300 psec. Pulse amplitudes to 5 kV may be attenuated by a factor of 10, allowing the use of high speed, lower voltage commercial attenuators for reduction of the pulses to oscilloscope levels. The mechanical and electrical design maintains an impedance of 50 ohm. 2 Refs.  
Primary Keywords: Resistive Voltage; Coaxial Configuration; Compensated; Subnanosecond Rise Time  
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3648  
(SWITCHES, CLOSING)  
(Gas Gaps, Optical)  
SWITCHING JITTER IN SPARK GAP TRIGGERED BY A TEM/SUB 00/-MODE MODE-LOCKED RUBY LASER  
D. Milem, C.C. Gallagher, R.A. Bradbury and E.S. Bliss  
AFCL, Bedford, MA 01730  
The Review Of Scientific Instruments, Vol. 43, No. 10, pp 1482-1484  
(10/1972).  
The first study of jitter in a laser triggered spark gap switched by pulse trains from a mode-locked ruby laser is described. The spark gap was fired by producing gas breakdown in a high pressure argon nitrogen mixture between the pole pieces. Jitter was measured as a function of the position of the lens used to focus the laser beam and as a function of the ratio of the applied voltage to the self-breakdown voltage of the gap. Jitter values of less than 2 nsec were obtained under optimum conditions provided that the gap was fired by the early part of the pulse train. 10 Refs.  
Primary Keywords: Ruby Laser; Argon-nitrogen Gap; Focal Plane Position Variation; Applied Voltage Variation; Jitter Measurement  
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3649  
(INSULATION, MATERIAL)  
(1)

SYNTHETIC PAPER FOR EXTRA HIGH VOLTAGE CABLE  
T. Yamamoto, S. Ishiki and S. Makayama  
The Fujikura Cable Works, Ltd.  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-91, No. 6, pp 2415-2426 (12/1971).  
Extra high OF cables insulated by synthetic paper exclusively made of synthetic polymer were developed. It has been proved that the synthetic paper, given a structure similar to conventional paper, showed more favorable electric and physical characteristics and oil resistance, thus solving problems of extra high OF cables using films for insulation. This improvement is due to a structure having minute pores. This report develops considerations on this point. Trial OF cables with the synthetic paper for insulation were produced and tested on their characteristics; the measured results were satisfactory. Heating tests by loading power were conducted on its model samples. The test results showed that the synthetic paper is superior over the kraft paper as the insulator because of better heat resistance of its component polymers. 9 Refs.  
Primary Keywords: Synthetic Kraft Paper; Artificial Fiber; Polymer Material  
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3656  
(POWER CONDITIONING)  
(Pulse Forming Lines)

A TRANSMISSION LINE CIRCUIT FOR RELIABLE SPARK GAP OPERATION  
C. L. M. Ireland  
University College of Swansea, Singleton Park, Swansea, Wales  
The Review Of Scientific Instruments, Vol. 43, No. 9, pp 1378-1379 (09/1972).  
The common transmission line circuits employed to enable a fast laser triggered spark gap to switch an optical cell are discussed. A modification is suggested that leads to a more reliable operation of the gap. 5 Refs.  
Primary Keywords: Laser Triggered Spark Gap; Two Circuits; Pulse Shaping  
Secondary Keywords: Laser Light Pulse Shaping  
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3676  
(BREAKDOWN STUDIES)  
(Gas, Electrical)

INFLUENCE OF CORONA DISCHARGES ON THE BREAKDOWN VOLTAGE OF AIRGAPS  
K. Feser  
Haefely Ltd, Basel, Switzerland  
Proceedings Of The IEE, Vol. 118, No. 9, pp 1309-1313 (09/1971).  
The authors consider the role of corona in the variation of breakdown voltage in rod-rod and rod-plane air gaps. The breakdown characteristics for several gap spacings are observed, along with the predischage corona in each case. An attempt is made to separate the contribution of corona to breakdown for several waveshapes of both polarities. 20 Refs.  
Primary Keywords: Breakdown Voltage; Rod-rod Gap; Rod-plane Gap; Pre-breakdown Corona; Effect On Breakdown  
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3686  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)

PULSED LASER KERR SYSTEM POLARIMETER FOR ELECTRO-OPTICAL FRINGE PATTERN MEASUREMENT OF TRANSIENT ELECTRICAL PARAMETERS  
E.C. Cassidy  
National Bureau of Standards, Washington, DC 20234  
The Review Of Scientific Instruments, Vol. 43, No. 6, pp 886-893 (06/1972).  
Novel electro-optical fringe pattern methods are developed for measurement of transient high voltages and electric fields. Several techniques employing the Kerr effect, a pulsed laser source, and high speed photographic recording equipment are described. Typical fringe pattern results are compared with conventional resistive divider measurements. 13 Refs.  
Primary Keywords: Impulse Voltage Measurement; Kerr Effect; Crossed Polarizer  
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3688  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES)  
(Vacuum, Electrical; Vacuum, Magnetic Field)

REDUCTION OF SPARKING VOLTAGES DUE TO A MAGNETIC FIELD PARALLEL TO THE AXIS OF ROD ELECTRODES  
M. J. Rofoed and H.V. Cleve  
Boeing Aerospace Co, Seattle, WA 98124  
Journal Of Applied Physics, Vol. 42, No. 13, pp. 5392-5396 (12/1971).  
Round-rod electrodes with flat ends were aligned with the axis of a glass vacuum chamber. They were completely insulated by close-fitting glass except for the 1.0-cm-diam ends which faced each other to form a 2.5-cm-long spark gap. Sparkover voltage tests were made at 5 and/or 40 micron in Ar, Ne, He, N/sub 2, and air. An unexpected dramatic and sudden decrease in sparkover voltage occurred in all gases when a modest steady uniform magnetic field was applied parallel to the axis of the electrodes. 4 Refs.  
Primary Keywords: Breakdown Voltage Reduction; Parallel Magnetic Field  
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3689  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)

RESISTOR DIVIDER WITH DIVIDING ELEMENT ON HIGH VOLTAGE SIDE FOR IMPULSE VOLTAGE MEASUREMENTS  
T. Harada (1), Y. Aoshima (1) and T. Imai (2)  
(1) Central Research Institute of The Electric Power Industry, Tokyo, Japan  
(2) Shikoku Electric Power Co., Takamatsu, Japan  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-90, No. 3, pp 1407-1416 (06/1971).  
The response characteristics of a resistor divider with dividing element on high voltage side were investigated theoretically and experimentally. As the results, it was revealed that it could be realized a divider having an excellent response characteristic by this method. 3 Refs.  
Primary Keywords: Resistive Divider; Floating Ground; Stray Capacitance; Error; Measurement Theory  
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3691  
(BREAKDOWN STUDIES; DIAGNOSTICS AND INSTRUMENTATION)  
(Gas, Electrical; Miscellaneous)

SPECTROSCOPIC INVESTIGATION OF THE SPARK CHANNEL  
M.M. Kekez, M.R. Barreault and J.D. Craggs  
University of Liverpool, Liverpool, UK  
Journal Of Applied Physics, Vol. 5, pp 253-265 (07/1971).  
The different processes involved during the formation of spark discharges in hydrogen have been studied by the use of a spectrophotographic method. The voltage collapse across the gap during what is described as the second glow phase has been computed for a simple model, and good agreement between this and experimental results was found over a wide range of the experimental conditions. 19 Refs.  
Primary Keywords: Spark Channel; Voltage Fall; Formative Time Log; Experiment; Theory  
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3698  
(SWITCHES, CLOSING)  
(Gas Gaps, Materials)

ENERGY DISSIPATION AND ELECTRODE EROSION IN ARCS  
H.G. Heard  
Levinthal Electronic Products, Inc., Palo Alto, CA  
Interim Report Prepared Under AFRC Contract No. AF 19(604)-1856 (10/1956).  
Availability: AD 117031  
NTIS

A survey is made of the mechanisms of energy dissipation and electrode erosion in the DC and in the transient arc discharge at atmospheric pressure and in high vacuum. Loss of electrode material is shown to be due to electrochemical and electrokinetic processes. The scope of the report is confined to electrochemical and electrokinetic processes. It is concluded that erosion from the anode is due to evaporation whereas erosion from the cathode may be due to direct sublimation as well as evaporation. It is proposed that the onset of electrode erosion is governed by the thermodynamics of the evaporation process. This model predicts that electrode erosion is a threshold phenomenon. Appreciable erosion is expected only when the mechanism of the electric arc produces a net energy in excess of the heat of vaporization of the material. If the net energy released at the electrode is less than this value, the model predicts negligible erosion. Recommendations are included which are expected to reduce the rate of erosion in a spark gap. If the erosion rate cannot be reduced, the useful life of the spark gap may be extended by methods outlined here. 38 Refs.  
Primary Keywords: Electrode Erosion; DC Arc; Impulse Arc; Electrochemical Process; Electrokinetic Process; Evaporation; Sublimation; Electrode Life Extension

3699  
(SWITCHES, CLOSING; BREAKDOWN STUDIES)  
(Vacuum Gaps, Self; Vacuum, Electrical)

AC (50 HZ) AND DC ELECTRICAL BREAKDOWN OF VACUUM GAPS AND WITH VARIATION OF AIR PRESSURE IN THE RANGE 1E-9-1E-2 TORR USING OFHC COPPER, NICKEL, ALUMINUM, AND NIOBIUM PARALLEL PLANAR ELECTRODES  
R. Hackam and L. Altschuh  
University of Sheffield, Sheffield, UK  
Journal Of Applied Physics, Vol. 46, No. 2 (05/1974).  
Breakdown potentials of vacuum gaps are measured over a wide range of air pressure using both direct and alternating applied voltage and employing four different electrode materials. The air pressure is varied in the range 2E-9 - 2.5E-2 Torr for DC and 6E-7 - 2.5E-2 Torr for AC applied voltage. OFHC copper, nickel, aluminum, and niobium are used to fabricate the electrodes. It is found that the peak AC breakdown voltage is usually higher than the DC voltage for a fixed electrode separation and a fixed gas pressure. Under certain conditions considerable improvement in the insulating property of the gap can be obtained in semivacuum. The improvement in the breakdown voltage of the gap is considerable and can reach up to 62% in some cases. The higher breakdown voltage is attributed to the increased work function of the metal-gas adsorbate system. 62 Refs.  
Primary Keywords: Vacuum Gap; Breakdown; DC Breakdown; AC Breakdown; Several Electrode Materials; Variable Electrode Separation  
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3700  
(BREAKDOWN STUDIES)  
(Lightning)

ARTIFICIAL INITIATION OF LIGHTNING DISCHARGES  
M. Brook (1), G. Armstrong (2), R.P.H. Winder (3), B. Vonnegut (4) and C.B. Moore (4)  
(1) New Mexico Institute of Mining and Technology, Socorro, NM  
(2) Museum Of Science, Boston, MA  
(3) Office of Naval Research, Boston, MA  
(4) Arthur D. Little, Inc., Cambridge, MA  
Journal Of Geophysical Research, Vol. 66, No. 11 pp. 3967-3969 (11/1961).  
It was found that small currents of several milliamperes flow through a wire suspended beneath a storm creating an electric field that shields it from the lightning. Experiments were then performed in which a readily introduced wire caused a discharge from a Van de Graaf generator. The authors then theorized that a wire introduced readily beneath a storm might artificially cause a discharge. 2 Refs.  
Primary Keywords: Lightning Initiation; Space Charge Neutralization; Pseudo Wire  
Secondary Keywords: Clouds; Pockets  
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3701  
(INSULATION, MATERIAL; BREAKDOWN STUDIES)  
(Solid, Vacuum, Electrical)

AUTOMATED PARTIAL-DISCHARGE TESTING OF TRAVELING-WAVE TUBES  
K.W. Parthen and F. Hay  
Aerospace Corp, El Segundo, CA 90245  
AFSC Report No. 50-TR-81-38 (05/1981).  
Availability: AD A099379  
NTIS  
A test system is described that is used in the Materials Sciences Laboratory to evaluate the quality of high-voltage insulation in traveling-wave tubes. Evaluation is performed by quantitatively recording the occurrence of partial discharges during temperature cycling in vacuum for extended periods. 0 Refs.  
Primary Keywords: Corona; High-Voltage Test; Partial Discharge  
Secondary Keywords: Automation; Traveling-Wave Tubes



3702  
(PULSE GENERATORS; ENERGY STORAGE)  
(Systems; Systems)  
CONCEPTS STUDY FOR NANOSECOND RISETIME MULTI-MEGAJOULE IMPULSE POWER SYSTEMS

D. Halder  
Army Missile Command, Redstone Arsenal, AL 35809  
Technical Report No. AG-75-52 (06/1975).  
Availability: AD A014985  
NTIS

This report considers the concepts, techniques, and limitations of means for controlling the flow of extremely high electric currents and the production of very rapid rates of change of current through a load. Circuit-opening, and circuit-closing switches as well as a combination of the two for switching a source into a load are considered. 14 Refs.  
Primary Keywords: Closing Switches; Opening Switches; Exploding Wire; Restriks; Spark Gap; Resistive Phase; Capacitive Energy Storage; Inductive Energy Storage  
Secondary Keywords: Crossed-field Switch

3703  
(ENERGY STORAGE; MECHANICAL)  
(Rotating Machines)  
CONCEPTUAL ENGINEERING DESIGN OF A ONE-GJ FAST DISCHARGING HOMOPOLAR MACHINE FOR THE REFERENCE THETA-PINCH FUSION REACTOR

K.I. Thomassen  
Los Alamos National Labs, Los Alamos, NM 87545  
EPRI Report No. EPRI ER-246 (08/1976).  
Availability: EPRI ER-246  
EPRI

The design of a fast discharging homopolar machine (30 ms) storing 1.3 GJ of energy is described. Electrical, mechanical, and thermal considerations are included. The machine is designed to operate reversibly into an inductive load, with a 95% cycle efficiency. Other fusion applications of this type of machine are also described. 43 Refs.  
Primary Keywords: Design Considerations; High Efficiency; Applications  
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3704  
(POWER CONDITIONING)  
(Pulse Transformer)  
DEVELOPMENT OF A 3 MV PULSE TRANSFORMER

G.J. Rohwein  
Sandia Labs, Albuquerque, NM 87115  
Sandia Report No. SAND79-0813 (05/1979).  
Availability: SAND79-0813  
NTIS

This report describes a 3 MV transformer designed for charging high voltage pulse forming transmission lines. The transformer is an air core spiral strip design which incorporates ring cage shielding to control edge breakdown in the secondary winding. The physical features of the transformer are described along with its electrical characteristics and the operational results. 8 Refs.  
Primary Keywords: Pulse Transformer; Pulse Forming Network; Small Size; Multimegavolt  
Secondary Keywords: Capacitor Bank; Spark Gap

3705  
(SWITCHES; CLOSING; BREAKDOWN STUDIES)  
(Vacuum Gaps; Self; Vacuum; Electrical)  
EFFECTS OF ELECTRODE CURVATURE, DISTANCE FROM GLASS INSULATOR, AND ADDITION OF HYDROGEN ON FIELD-EMISSION CURRENTS AND BREAKDOWN VOLTAGE IN VACUUM

R. Mackam and S.K. Salman  
University of Sheffield, Sheffield, UK  
Journal of Applied Physics, Vol. 45, No. 10 pp 4384-4392 (10/1974).  
Measurements of the prebreakdown currents have been made for highly polished stainless-steel electrodes in an ultrahigh vacuum at  $1E-9$  Torr as a function of electrode separation in the range 0.5-3.81 mm. Three sets of electrodes are employed to investigate the dependence of the prebreakdown current on the radius of curvature of the electrodes and the electrodes-insulator distance. The breakdown potentials is measured in UHV gaps over the gap length range 0.25-4.57 mm and in hydrogen, in the pressure range  $3 \times 10^{-9}$ - $1.5 \times 10^{-2}$  Torr, over the gap length range 0.35-16 mm. It has been found that the breakdown voltage, the electric field enhancement factor, and the prebreakdown current are independent of electrode-glass-insulator distance in the range 1-12.65 mm for a fixed gap length and a fixed radius of curvature of the electrodes. On the other hand, increasing the radius of curvature of the edge of the flat electrodes, at a fixed gap length, results in (i) large increases in the prebreakdown current, (ii) increase in the electric field enhancement factor, (iii) the cathodic and (iv) a decrease in the breakdown voltage. The addition of hydrogen causes an increase in both the prebreakdown current and the field enhancement factor, at a fixed gap distance. 67 Refs.  
Primary Keywords: Vacuum Breakdown; Prebreakdown Current; Electrode Geometry; Glass Insulator  
Secondary Keywords: Stainless Steel Electrode  
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3706  
(SWITCHES; CLOSING; SWITCHES; OPENING; BREAKDOWN STUDIES)  
(Gas Gaps; Materials; Gas Gaps; Materials; Electrodes)  
ELECTRODE PHENOMENA IN A HIGH CURRENT, DC NANOSECOND SPARK

H. Fischer and C. Gallagher  
AFRL, Bedford, MA 01730  
Applied Optics, Vol. 6, No. 12 p. 2076-2077 (07/1967).  
Directed flames from the arcing of a 0.45 mm gap in 1 atm of air appear to be a type of explosive erosion, appearing after current cutoff. A Kerr cell is used to observe the initial electrode processes. The development of the spark channel and the related afterglow are also discussed. 11 Refs.  
Primary Keywords: Electrode Erosion; Metal Vapor Jets; Optical Phenomena; Twenty Nanosecond Duration  
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3707  
(SWITCHES; CLOSING; SWITCHES; CLOSING)  
(Vacuum Gaps; Electrical; Vacuum Gaps; Materials)  
FIRING CHARACTERISTICS OF A TRIGGERED VACUUM GAP EMPLOYING DIELECTRIC COATING WITH A SEMICONDUCTING LAYER

G.R. Govinda Raju, R. Mackam and F.A. Benson  
University of Sheffield, Sheffield, UK  
Journal of Applied Physics, Vol. 48, No. 3 pp 1101-1105 (05/1976).  
Some electrical properties of a triggered vacuum gap incorporating five different dielectric materials coated with a semiconducting layer to produce a low surface resistance are studied. The dielectric materials used are high-alumina ceramic, stannite ceramic, osmium titanate, silicon carbide, and boron nitride. It has been found that the probability of firing and the time delay to firing generally decreases with an increase of both the trigger energy and the trigger voltage until saturation is reached. The minimum trigger voltage for successful firing is about 300 V for all substrates except for barium titanate which is higher at 700 V. The higher trigger voltage in the case of barium titanate is attributed to the difficulty of coating this material evenly with the particular semiconducting layer used of colloidal solution of aquadag carbon. A new method is described to rejuvenate a IVG which ceased to operate by applying a keep-alive direct current superimposed on the trigger pulse voltage. A mechanism responsible for this phenomena is also discussed. 10 Refs.  
Primary Keywords: Triggered Vacuum Gap; Multiple Dielectrics; Semiconductor Coating; Aquadag Copper Electrodes  
Secondary Keywords: Reliability  
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3708  
(PARTICLE BEAMS; ELECTRON)  
(Reviews)  
HIGH POWER RELATIVISTIC ELECTRON BEAMS IN PLASMA AND IN VACUUM

B.N. Breizman and D.D. Ryutov  
Institute of Nuclear Physics, Academy of Sciences of the USSR, Novosibirsk, USSR  
Sandia Report No. SAND-74-6022 (01/1975).  
Trans. From: Preprint 179-74 By P. Newman  
Availability: SAND-74-6022  
NTIS

In this review the authors discuss the possibilities of using high power relativistic electron beams for plasma heating in open systems. We shall consider the following three groups of questions: 1. Beam transport in a vacuum in a strong magnetic field, equilibrium, stability, and critical beam currents in vacuum. 2. Beam transport in plasma, charge and current neutralization of the beam, plasma heating by a reverse current, macroscopic beam instabilities in plasma. 3. Theory of collective beam relaxation in plasma, including quasi-linear and nonlinear relaxation models, the role of plasma instability; macroscopic effects during beam relaxation. The review encompasses results published up to September 1973. 71 Refs.  
Primary Keywords: Relativistic Electron Beam; Beam-Plasma Interaction; Vacuum Transport; Critical Beam Current  
Secondary Keywords: Instabilities; Relaxation

3709  
(INSULATION; MATERIAL)  
(Liquid)  
INFLUENCE OF SPECIMEN SIZE ON THE DIELECTRIC STRENGTH OF TRANSFORMER OIL

N.R. Bell  
University of Newcastle Upon Tyne, Newcastle Upon Tyne, UK  
IEEE Transactions On Electrical Insulation, Vol. EI-12 No. 4 pp 281-292 (08/1977).  
The results of some specimen size effect experiments on technical grade transformer oil are reported. Four electrode areas (1.77, 8.19, 37.9 and 177 sq.cm.) and four gap spacings (0.215, 0.464, 1.0 and 2.15 mm) were investigated using test ramp  $5 \times 1E12$  V/cm/sup -1/ sec/sup -1/ and an AC ramp (12 kV/cm/sup -1/ sec/sup -1/). Whilst the results are in general agreement with weak link theories, it is suggested that physical specimen size factors play a significant part. Examples of physical size factors are spark conditioning, electrode profile, and liquid motion. 18 Refs.  
Primary Keywords: Dielectric Strength; Transformer Oil; Specimen Size Influence; Uniform Field; Plane Electrodes; Parallel Electrodes; Electrode Effects  
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3710  
(SWITCHES; CLOSING; SWITCHES; OPENING)  
(Gas Gaps; Materials; Gas Gaps; Materials)  
INVESTIGATION OF THE EROSION PHENOMENA IN HIGH CURRENT, HIGH PRESSURE GAS DISCHARGES

J.E. Gruber and R. Suss  
Institut für Plasmaphysik, Garching, FRG  
IPP Report No. IPP 472 (12/1969).  
Erosion, resulting from discharges whose total current is between 1 and 10 kA, was measured for electrode gaps of 1.5 mm and 13 mm and for pressures from 1 to 5 atm at a gap separation of 1.5 mm. Pressure was found to have no effect on the electrode erosion whereas the gap distance did. Experiments were done for Aluminum, Brass, Stainless Steel, Molybdenum, Tungsten and Tungsten-Copper electrodes. 0 Refs.  
Primary Keywords: Electrode Erosion; Parallel Electrodes; Small Charge Conductors; Variable Gap Width; Several Electrode Materials



3721

(BREAKDOWN STUDIES)  
(Gas, Optical)

## BREAKDOWN OF AIR NEAR TRANSPARENT DIELECTRICS

A.M. Bonch-Bruyevich, V.I. Zinchenko and L.N. Kaporski  
Soviet Physics Technical Physics, Vol. 22, No. 5, pp. 629-631 (06/1976).  
Trans. From: Zh. Tekh. Fiz. 47, 1055-1058 (May 1977)

An experimental study is made of the breakdown of air near the surface of a transparent target irradiated by a series of giant pulses. The observed decrease in the breakdown threshold is not due to processes occurring at the focus of the lens focusing the radiation. The breakdown of air is initiated in the immediate vicinity of the dielectric surface and is not affected by the distance from the focus to the surface. The breakdown of air near the surface of a dielectric is not due to evaporation of the dielectric material. It is suggested that the breakdown is initiated by microscopic inhomogeneities which result from the contact of the surface with the surrounding medium. 7 Refs.

Primary Keywords: Air Discharges; Dielectrics; Laser-initiated Breakdown

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3722

(SWITCHES, CLOSING; BREAKDOWN STUDIES)

(Gas Gaps, Self; Gas, Electrical)

## COMPUTATION OF IONIZATION GROWTH AT HIGH CURRENT DENSITIES

A.J. Davies and P.M. Woodson  
University College of Swansea, Singleton Park, Swansea, Wales  
Proc. IEE, Vol. 122, No. 7, pp. 765-768 (12/1974).

The paper gives a numerical method for integrating the differential equations describing the ionization of gases in the discharge gap between electrodes. The method improves upon previous work in that it allows the discharge to be traced through the later stages up to currents of 20-100A. The computed data is found to agree closely with previous experimental values of light output and total current. 8 Refs.

Primary Keywords: 1-dimensional Ionization; Plane Electrodes; Parallel Electrodes; Small Gap; Theory; Experiment

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3723

(SWITCHES, CLOSING)

(Gas Gaps, Electrical)

## HIGH POWER SPARK GAP SWITCH DEVELOPMENT

M. Clark  
Maxwell Labs Inc, San Diego, CA 92123  
AFAPL Report No. AFAPL-TR-75-41 (05/1975).  
Availability: AD-A015 072

NTIS

A pressurized spark gap switch is described which is capable of high repetition rates in the multi-megawatt average power range. This switch used air flow to remove the hot gas generated by the conduction current. A two electrode pair version of this switch has been operated at repetition rates up to 500 pps and simulated average power levels up to 5.6 megawatts in bursts of several seconds with an air flow on the order of 150 CFM per electrode pair. The switch was tested using a simulation technique which duplicates the high power electrical waveforms experienced by the switch but requires less operating power than is transferred to the load under actual operating conditions. Using this testing scheme, a broad base of statistical experimental data was generated on spark gap switch operation at high average power levels. The data from these tests indicates that the switch performance is strongly influenced by the gas flow velocity in the gap region. This velocity is determined by the electrode shape, the gas flow geometry, the gas flow rate, the gas pressure, and the gap length. Other important variables involved were found to be the switch voltage, the electrical charge transferred per shot, the recharging voltage rise time, the pulse repetition frequency, and the grace period or zero voltage time. 47 Refs.

Primary Keywords: High Power Spark Gap Switches; High Repetition Rate Switches; Switches For High Power Pulse Modulators; Spark Gap Switches

3724

(BREAKDOWN STUDIES)

(Gas, Optical)

## MEASUREMENT OF THE WAVELENGTH DEPENDENCE OF THE THRESHOLD OF LASER-INDUCED GAS BREAKDOWN

K.C. Byron and G.J. Part  
University of Hull, Hull, UK  
J. Phys. D: Appl. Phys., Vol. 12, pp. 401-404 (07/1978)

Experiments are described which study the wavelength scaling of cascade breakdown. A tunable dye laser with a peak output power of 60 mW in a 18 ns pulse, is used over a wavelength range of 720-840 nm to measure the threshold breakdown intensity in the rare gases helium, argon, and krypton, and in the molecular gases hydrogen and sulphur hexafluoride all at 760 Torr. The data obtained for the rare gases agreed well with the cascade breakdown theory while the molecular gases varied greatly from the theory possibly due to the effects of molecular vibrational levels. 12 Refs.

Primary Keywords: Gas Discharges; Laser-induced Breakdown; Wavelength Dependence; Focal-spot Dependence; Breakdown

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3725

(PARTICLE BEAMS, ION)

(Generation)

## MICROSECOND OPERATION OF A GENERAL PURPOSE PULSED PROTON GUN

S. Humphries and G.W. Kusin  
Sandia Labs, Albuquerque, NM 87115  
Applied Physics Letters, Vol. 35, No. 3, pp. 13-16 (07/1979).

A magnetically insulated guided proton gun is described that provides an extracted parallel beam of annular cross section for microsecond pulse lengths. In initial tests, time-averaged currents of 5 kA and current densities of 50 A/cm<sup>2</sup> were achieved with a 200 kV voltage. The behavior of the gun appears to be determined by instabilities of the cathode electron cloud growing over time scales of the order of 0.5 microseconds to give ion current density enhancements greater than a factor of 50 above the Child-Langmuir limit. 5 Refs.

Primary Keywords: Magnetic Insulation; Annular Cross Section; Microsecond Pulse Length; Cathode Instability

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3726

(BREAKDOWN STUDIES)

(Gas, Optical)

## MODELING OF THE BREAKDOWN OF A DENSE MOLECULAR GAS BY LASER RADIATION CLOSE TO A METALLIC SURFACE

V.I. Mezhekin, A.A. Uglov and B.N. Chatverushkin  
M.V. Keldysh Institute Of Applied Mathematics, Academy of Sciences of the USSR

Soviet Physics Doklady, Vol. 24, No. 6, pp. 443-446 (06/1979).  
Trans. From: Doklady Akademii Nauk SSSR 246, 1338-1342 (June 1979)

The authors use methods of numerical simulation to investigate the phenomenon of optical breakdown of molecular nitrogen by laser radiation with wavelength 1.06 microns under conditions when the high pressure essentially suppresses the processes of vaporization of the target substance, and when the thermal emission of electrons from the surface of a molybdenum disk exerts a direct effect on the breakdown mechanism, which, as is known, is an avalanche-ionization process in the region of  $P \gg 1$  atm. 5 Refs.

Primary Keywords: Molecular Gas Breakdown; Neodymium Laser; Metallic Surface; Numerical Calculation

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3727

(ENERGY CONVERSION, ELECTRICAL; PULSE GENERATORS)

(Power Supplies, Reviews)

## ANALYSIS OF PHASED ARRAY RADAR POWER SUPPLY SYSTEMS OPERATING UNDER VARIABLE PULSE LOADING CONDITIONS

C.J. Eichenauer

General Electric Co, Syracuse, NY 13201

IEEE 1973 Eleventh Modulator Symposium pp. 136-149 (09/1973).

Detailed quantitative analyses of phased array power systems are often required as a result of the radar system's variable pulse format operating conditions. A matrix format, with system capability factors forming columns and system operating modes forming rows, is presented as a useful type of display for the quantitative results of a power supply system analysis. Four alternate forms of system analysis are then examined: use of steady state techniques, use of analog computer techniques, development and use of special purpose digital computer programs, and use of one of the general purpose user oriented circuit analysis programs. Examples of a power supply system analog computer analysis and a CIRCUS 2 digital analysis are presented. Advantages and disadvantages of each method of analysis are discussed. 0 Refs.

Primary Keywords: Power Supply; Analysis Techniques; Analog Computer; Digital Computer

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3728

(SWITCHES, CLOSING)

(Gas Gaps, Materials)

## NONLINEAR SURFACE PHOTOELECTRIC EFFECT IN METALS SUBJECTED TO INTENSE LIGHT

I.I. Kantorovich

V.I. Lenin Belorussian State University, Minsk

Soviet Physics Technical Physics, Vol. 22, No. 3, pp. 397-399 (03/1977).  
Trans. From: Zh. Tekh. Fiz. 47, 660-664 (March 1977)

Recently there has been renewed interest in the surface photoelectric effect of metals. When a metal is irradiated by a laser the photoelectric effect is nonlinear. In the present note we derive a general equation for the electron emission current. 5 Refs.

Primary Keywords: Surface Photoelectric Effect; Laser Light; K-photon

Secondary Keywords: Fermi Energy

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3729

(INSULATION, MATERIAL; INSULATION, VACUUM; SWITCHES, CLOSING; SWITCHES,

OPENING; REVIEWS AND CONFERENCES)

(Reviews, Reviews; Reviews, Reviews; Reviews)

## REVIEW OF DIELECTRICS AND SWITCHING

A. S. Denholm

Energy Sciences Inc., Bedford, MA 01730

AFML Report No. AFML-TR-72-88 (02/1973).

Availability: AD 807739

NTIS

Systems to generate high power levels frequently operate at high voltage, and their design requires special knowledge of dielectric and switching technology. The treatment of these technologies in this report starts with a discussion of electric field analysis then covers insulation and switching in the four dielectric media; namely gas, solid, liquid and vacuum. An extensive search of the literature produced a listing of relevant books, reports and papers and the establishment of a punched card classification and retrieval system specially designed for the subject area. 6 Refs.

Primary Keywords: Electric Field Profile; Dielectric Properties; Breakdown; Tracking; Solid State Switches; Circuit Breakers; Spark Gaps

3730

(BREAKDOWN STUDIES)

(Gas, Electrical)

## AFTERGLOW TAILS AND STABILITY OF HIGH-DENSITY NANOSECOND ARC CHANNELS

M. Fischer and W. Ruppel

AFAPL, Bedford, MA 01730

Applied Optics, Vol. 3, pp. 769-772 (08/1963).

Experiments are presented which study the afterglow tail of a 10 ns arc channel in air at 760 Torr. The photodetector was protected from saturation by a gated Kerr cell which reduced some intensities by a factor of four. Multishots are used to get integrated arc images with delays up to 500 ns. 3 Refs.

Primary Keywords: Afterglow Tail; Arc Channels; Spectral Intensity; Temporally Resolved

Secondary Keywords: Kerr Cell

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3731  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
THEORETICAL AND EXPERIMENTAL INVESTIGATION OF PULSED DISCHARGES IN GASES  
V. Yu. Baranov, Yu. V. Petrushevich, Yu. B. Smakovskiy, A. N. Starostin  
and A. P. Stral'sov  
Soviet J. Quantum Electronics, Vol. 9, No. 12, pp. 1509-1515 (12/1979)  
Trans. from: Kvantovaya Elektronika (Moscow) 6, 2552-2561 (December 1979)  
A numerical investigation was made of the properties of pulsed  
self-sustained discharges in gases, and of the ways in which their  
development was affected by nonmonotonic dependencies on the electron  
drift velocity on the ratio of the field to the density and on other  
parameters. The procedure used made it possible to perform  
calculations for discharges having large discharge gaps and, at the  
same time, to study the detailed distributions of the electric field  
and of the ion and electron densities in the discharge gap. The  
calculations were in good agreement with the results of an  
experimental investigation of a large-volume nonself-sustained  
discharge. 34 Refs.  
Primary Keywords: Pulsed Discharges; Theoretical Investigation;  
Experimental Investigation; Self-Sustained;  
Nonself-sustained  
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3732  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
TRANSFORMER-TYPE HIGH-CURRENT ACCELERATOR  
Ye. A. Abramyan and V. A. Gaponov  
Institute of Nuclear Physics, Academy of Sciences of the USSR,  
Novosibirsk, USSR  
USCR Academy Of Sciences Monograph (03/1970)  
Trans. from: Monograph Siniotchniy Uskoritelna Osnova Transform  
Atura, Novosibirsk (1966)  
Availability: JPRS 50119  
N15  
This article contains a description of the operating principle of  
a direct-current accelerator designed to accelerate electrons to an  
energy of 1.5 megaelectron volts with an average beam power of tens  
of kilowatts and an efficiency of about 90 percent. The accelerator  
is a transformer with a core made up of insulated sections with a  
built-in accelerating tube operating on a 50 hertz network in a  
compressed gas environment. Constant electron energy is insured by  
voltage stabilization in the tube by means of current regulation. The  
pulse length of the electron current is regulated from zero to five  
microseconds, and the repetition rate to 50 times per second. The  
mean current can reach 1/6 of the maximum current in the pulse.  
Magnetic lenses are installed in the tube to bring an electron  
current up to 100 milliamperes through the accelerating tube in a beam  
with a diameter of several millimeters. Heavy metal shields near the  
tube axis protect the gas gaps and other electrically stressed  
sections of the accelerator from radiation. There is a structural  
description of a device in which an electron beam is obtained with an  
energy of 1.5 megaelectron volts and an average power of 25  
kilowatts. 6 Refs.  
Primary Keywords: Transformers; Accelerating Tube; Electron Beam;  
Hot-Cathode Diode

3733  
(PARTICLE BEAMS, ELECTRON)  
(Target Interactions)  
TWO-DIMENSIONAL FLUID SIMULATION OF RELATIVISTIC ELECTRON BEAM-HIGH Z  
TARGET INTERACTIONS  
D. G. Colombant and D. Mosher  
Naval Research Lab., Washington, DC 20375  
NRL Memorandum Report No. 3496 (05/1977)  
Availability: AD 8080  
N15  
A two-dimensional  $r-z$  fluid code has been developed to study the  
interaction between a relativistic electron beam and an anode plasma.  
A self-consistent treatment of the electromagnetic fields has been  
included. Radial pinching of the beam is observed when its self field  
resistively diffuses into the plasma. 8 Refs.  
Primary Keywords: Relativistic E-beam; Two-dimensional Fluid  
Simulation; Diode Flow; Pinch Formation

3734  
(SWITCHES, OPENING)  
(Explosive Fuses)  
WHYRAC, A NEW MODULAR ONE-DIMENSIONAL EXPLODING WIRE CODE  
D. G. Colombant (1), M. Lampe (1) and H. W. Bloembergen (2)  
(1) Naval Research Lab., Washington, DC 20375  
(2) Science Applications, McLean, VA 22209  
NRL Memorandum Report No. 3726 (02/1978)  
Availability: AD A051847  
N15  
A new one-dimensional code, WHYRAC, intended to provide a  
comprehensive treatment of exploding wires and wire arrays, is  
described. The circuit equations treat the wire plasma in an exact  
way, rather than using a lumped circuit model. Great care has been  
taken in the Eulerian MHD treatment of plasma motion, resulting in an  
unusual combination of rapid running capability to handle density  
ranges spanning at least four orders of magnitude, and very accurate  
energy conservation in the overall circuit. The code is written in a  
modular and flexible way, to permit continual upgrading, and  
extension to different elements of the atomic physics and radiation  
transport packages. At present, a fairly simple, rapid-running model  
is used to provide transport at each time step. A much more  
extensive, state of the art, atomic radiation code is used to  
generate output radiation for the wire, ionization, and to benchmark the  
energy transport package. The code is given special attention to the  
treatment of numerical problems in WHYRAC. 11 Refs.  
Primary Keywords: Z pinches; Wire Pinched Plasma; Numerical MHD

3735  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
SIMULATION OF THE GROWTH OF AXIALLY SYMMETRIC DISCHARGES BETWEEN PLANE  
PARALLEL ELECTRODES  
A. J. Davies, C. J. Evans and P. M. Widdison  
University College of Swansea, Singleton Park, Swansea, Wales  
Computer Physics Communications Vol. 14, pp. 287-297 (12/1977)  
A program is presented that uses a two-dimensional numerical  
method to simulate the complete radial and axial development of an  
axially symmetric discharge. The processes of primary ionization,  
excitation of gas atoms, attachment, detachment, and secondary  
emission from the cathode due to the incidence of photons and  
positive ions are taken into account. A test run for a discharge  
in air is included. 4 Refs.  
Primary Keywords: Discharges; Numerical Calculations; Plane Electrodes;  
Parallel Electrodes; Axially Symmetric  
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3736  
(PULSE GENERATORS)  
(Pulse Forming, Lines)  
NANOSECOND PULSES OF VERY LOW IMPEDANCE  
M. Fischer  
AFRL, Bedford, MA 01730  
AFRL Report No. AFRL 65-219 (04/1965)  
Availability: AD 614900  
N15

Nanosecond pulses exceeding 2000 A are obtained by discharging a  
plated-capacitor transmission line of very low impedance through an  
air gap. High repetition rates exceeding 20 kHz are possible; also  
triggered single shots with a time jitter of less than a nanosecond.  
A compact model of the pulser for generating a laser diode is  
described. Lower pulses covering a wide current range conveniently  
are produced by the same geometry, using a mercury wetted contact  
switch. 7 Refs.  
Primary Keywords: Transmission Line Pulsers; Rep-rated; Low Jitter

3737  
(SWITCHES, CLOSING)  
(Miscellaneous)  
APPLICATION OF THE RSR SWITCH  
R. A. Hill and R. A. Smith  
Westinghouse Electric Corp., Baltimore, MD 21205  
IEEE 1973 Eleventh Modulator Symposium pp. 95-106 (09/1973)

The Reverse Switching Rectifier, a four layer-two terminal solid  
state switch, has been successfully applied in several pulse  
modulator designs. The modulators have demonstrated high reliability  
and have achieved a substantial reduction in size and weight compared  
to conventional designs. Thorough testing has been performed,  
including extensive operation under load fault conditions. The RSR  
modulator design techniques are now being applied in a number of new  
programs. 5 Refs.  
Primary Keywords: Reverse Switching Rectifier Switch; Solid State  
Switch; High Reliability; Light Weight  
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3738  
(PULSE GENERATORS)  
(Hard-tube)  
A CONSTANT CURRENT HARD TUBE MODULATOR  
R. Alsmeyer  
Raytheon Co., Wayland, MA 01778  
IEEE 1973 Eleventh Modulator Symposium pp. 75-78 (09/1973)

Modern air defense radars require reliable stable high-power  
transmitters. This paper describes the modulator for the final  
amplifier stage for such a transmitter. It is a completely solid state  
exciter for the high-power switch tube and the crowbar spark gap. The  
modulator drives a crossed field amplifier tube. 7 Refs.  
Primary Keywords: Constant Current; Solid State; Crossed-field  
Amplifier  
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3739  
(SWITCHES, CLOSING)  
(Miscellaneous)  
A NEW SOLID STATE SWITCH FOR POWER PULSE MODULATOR APPLICATIONS, THE  
REVERSE SWITCHING RECTIFIER  
J. B. Brewster and R. F. Pittman  
Westinghouse Electric Corp., Pittsburgh PA  
IEEE 1973 Eleventh Modulator Symposium pp. 6-9 (09/1973)

The Reverse Switching Rectifier is a new solid state switching  
device with performance optimized for short, high rate-of-rise pulse  
current switching. It is a two terminal device which switches from  
blocking to conduction upon application of a fast rising pulse of  
voltage. Devices with peak pulse current ratings of 1200 A and diode  
ratings of 2000 A/microseconds are available with blocking voltage  
ratings of 1000 V at 125 C. A typical value of turn off time is 50  
microseconds at 25 C. Many practical pulse modulator circuits have  
been built using series and parallel combinations of RSR's to  
demonstrate the use of this device in power pulse modulator service.  
6 Refs.  
Primary Keywords: Reverse Switching Rectifier; First Rise Time; Two  
Terminal Device; High-Voltage  
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3740  
(PULSE CONDITIONING)  
(Pulse Forming Networks)  
A POST CHARGE REGULATOR  
R. M. Smalley  
Raytheon Co., Wayland, MA 01778  
IEEE 1973 Eleventh Modulator Symposium pp. 184-188 (09/1973)

This paper describes a novel regulator for a line type modulator  
to reduce pulse-to-pulse load voltage ripple due to variations in PFN  
charging voltage. Control of the PFN voltage is accomplished by  
dividing the conventional PFN into two series-connected networks, and  
dissipating the excess charge on one of the networks. In many cases,  
the extra network can be a simple capacitor. Regulation is  
accomplished by use of a closed-loop regulator which senses the  
intermediate voltage of the series connection of PFN's and controls a  
solid state dissipative element to reduce the total voltage to the  
desired value. The dissipative element need only have a  
voltage rating somewhat greater than the peak to peak ripple  
voltage on the charge voltage existing without the regulator. The  
regulator is all solid state and is entirely self-ground biased. There  
is no necessity for a fault current diverter across the dissipative  
element, as a short to ground at any point in the circuit will not  
damage the regulator. In applications involving staggered repetition  
rates, a single modulator of pulse to pulse constant charge voltage  
can be obtained thus with regulators that maintain the D.C. HVPS  
within a constant. 10 Refs.  
Primary Keywords: Regulator; Pulse to pulse Voltage Ripple; Diode  
Dissipation  
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3741  
(SWITCHES, CLOSING; SWITCHES, OPENING)  
(EBS; EBS)  
CHARACTERISTICS AND CAPABILITIES OF THE MODULAR EBS  
R. T. Knight and D. J. Bates  
Watkins-Johnson Co., Palo Alto, CA  
IEEE 1973 Eleventh Modulator Symposium pp. 17-22 (09/1973).  
EBS devices have been designed, tested and are now available for use in a wide range of power modulation applications. Current multiplication due to electron beam illumination of a semiconductor diode results in rise times and delay times of a few nanoseconds, on-off ratios of 1E5 or more and the ability to provide multiple or coded output pulses. EBS devices have been tested which can provide up to 400 V output pulses with less than a 3 ns rise time and an EBS device designed for high current operation has been used to produce pulses of 250 A with a 1 ns rise time. EBS devices available at the present time can be used for CRT modulation, for the modulation of injection lasers and as TWT grid modulators. 0 Refs.  
Primary Keywords: EBS Devices; MJ-3650 Device; Current Amplification; Low Voltage  
Secondary Keywords: CRT Modulator; TWT Grid Modulator  
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3742  
(ENERGY CONVERSION, ELECTRICAL)  
(Power Supplies)  
CHARGING AND STABILISING SYSTEM FOR A PULSED CROSSED-FIELD AMPLIFIER USING AN SCR-SWITCHED ULTRASONIC INVERTER  
T. P. Crawford (1) and G. W. Whalley (2)  
(1) Admiralty Surface Weapons Establishment, Portsmouth, Hampshire, UK  
(2) GEC Marconi Research Labs, Essex, UK  
IEEE 1973 Eleventh Modulator Symposium pp. 176-183 (09/1973).  
The system described is used to provide a very stable 10 kV d.c. power supply for an RF switched CFA. The stability is provided by a novel quantum stabilisation method using a controllable high frequency inverter to charge an EHF reservoir capacitor to an accurately determined level. The use of a high inverter frequency greatly reduces the bulk of the power supply by eliminating all mains frequency transformers and filters. Similar techniques have also been successfully used for high stability pulse forming network charging systems. 3 Refs.  
Primary Keywords: Ultrasonic Inverter; Very High Stability; Crossed-field Amplifier; Thyristor  
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3743  
(PULSE GENERATORS)  
(Hard-tube)  
DESIGN AND PERFORMANCE OF THE LAMPF 1-1/4 MW KLYSTRON MODULATOR  
P. J. Tallierico, R. L. Gady and J. D. Doss  
Los Alamos National Labs, Los Alamos, NM 87545  
IEEE 1973 Eleventh Modulator Symposium pp. 56-60 (09/1973).  
A design for a very reliable single-triode modulator for a 1-1/4 MW modulating-anode klystron is presented. The operating voltage is 86 kV and the variable pulse length ranges from 200 microseconds to 1.2 msec. The basic modulator circuit, which uses a novel Zener diode bias circuit, and several of the individual components are described in detail. Over 140,000 high-voltage hours have been accumulated on these modulators. The principal failure mechanism is grid emission from the triode. The failures can be anticipated and repaired during a normal maintenance period. The triode is then reprocessed and reused. Tube life data and a summary of the failures modes are presented. 8 Refs.  
Primary Keywords: LAMPF Modulator; High Power; Zener Diode Bias Circuit; Failure Mechanisms; Life Test  
Secondary Keywords: Klystron Modulator  
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3744  
(POWER CONDITIONING)  
(Pulse Forming Networks)  
DESIGN CHARTS FOR DROOP-COMPENSATION NETWORKS  
T. A. Weil  
Raytheon Co., Weyland, MA 01778  
IEEE 1973 Eleventh Modulator Symposium pp. 156-161 (09/1973).  
The principles of pulse droop compensation with passive RLC networks are well known, but the practical application of these principles has been hindered by the complexity of analyzing even the simplest cases quantitatively. This paper presents the results of a computer analysis of droop-compensation methods. The tradeoffs are described, and the results are presented in charts that show directly the loss in efficiency versus the amount of droop before and after compensation. The charts also provide the data necessary to determine the component values to provide the selected droop-compensation performance. 1 Refs.  
Primary Keywords: Droop-compensation Network; Analysis; Design Considerations  
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3745  
(SWITCHES, OPENING)  
(Fuses)  
EVALUATION OF HVDC FUSES AS TWO PROTECTIVE DEVICES  
J. V. Stover  
Hughes Aircraft Co., Fullerton, CA  
IEEE 1973 Eleventh Modulator Symposium pp. 199-203 (09/1973).  
This paper describes itself with the evaluation of series-parallel assemblies of Bendix 5 kV, 1A rms fuses to protect 50 kV, 4A rms operation; the evaluation of Bendix 50 kV, 4A rms fuses; and the evaluation of Hughes 50 kV, 4A rms experimental fuses. The purpose of this evaluation was to determine the adequacy of the protection provided to a high power, grid pulse modulator traveling wave tube in an unattended, multiple transmitter system. Such a system may have several TWTs operating from a single power supply, and it becomes highly undesirable to shut down or crowbar the entire supply should only one tube experience a fault. 1 Refs.  
Primary Keywords: Development; Analysis; Evaluation  
Secondary Keywords: Traveling Wave Tube  
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3746  
EVALUATION OF STATE-OF-THE-ART HYDROGEN THYRATRONS AT EXTENDED RATINGS  
B. R. Gray  
RADCO, Griffiss AFB, NY 13440  
IEEE 1973 Eleventh Modulator Symposium pp. 227-231 (09/1973).  
Paper describes the background behind a comprehensive test on a group of selected off-the-shelf thyratrons. Specific objectives of the test were (1) determine the maximum operating anode voltage as a function of average current, (2) determine the maximum average current as a function of anode voltage, (3) determine short time on stability and (4) determine the above parameters with the tube operating in a vibration test stand. While the data is in the form of a preliminary report certain trends are evident. These are (1) the peak voltage which can be achieved is considerably above the rated value if average current is kept lower than rated value, (2) at rated voltage the average current is equal to or close to the rated value, and (3) average current can be raised above the rated value if anode voltage is lowered. 1 Refs.  
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3747  
(SWITCHES, CLOSING)  
(Gas Gaps, Optical)  
A CO/SUB 2/-LASER-TRIGGERED SPARK GAP  
A. V. Nurmikko  
University of California, Berkeley CA  
IEEE Journal Of Quantum Electronics, Vol. QE-7, No. 9, pp 470-471 (09/1971).  
A coaxial spark gap triggered by a high-pressure CO/sub 2/ laser has been constructed. High-voltage pulses with subnanosecond rise time and very low jitter have been obtained. The observed low laser energy threshold required to initiate switching suggests an application of the spark gap in controlling and manipulating higher intensity infrared radiation by electrooptic shutters. 3 Refs.  
Primary Keywords: CO/sub 2/ Laser; Coaxial Spark Gap; Tungsten Electrode; Nitrogen Gas; High Pressure; Low Jitter; Subnanosecond Rise Time  
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3748  
(PULSE GENERATORS)  
(Systems)  
HIGH POWER SOLID STATE MODULATOR FOR COHERENT AGILE MICROWAVE AMPLIFIER  
G. Scerchi  
Selenia SPA, Rome, Italy  
IEEE 1973 Eleventh Modulator Symposium pp. 84-88 (09/1973).  
The present paper describes a high power solid-state microwave amplifier realized for a pulse compression, M.T.I., or frequency agile radar system. After a short description of the amplifier global network, the most important solutions are pointed out, i.e., M.V. microsecond protections, grid modulator circuit, M.V.-ground level interface, amplifier processor. The overall performances obtained are also given. 10 Refs.  
Primary Keywords: Solid State Switches; Crowbar; Protection Circuit  
Secondary Keywords: TWT Modulator  
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3749  
(SWITCHES, OPENING)  
(Fuses)  
HIGH VOLTAGE FUSES FOR PHASED ARRAY RADAR TRANSMITTERS  
S. Schneider, A. Buffa and J. Carter  
ECOM, Fort Monmouth, NJ 07703  
IEEE 1973 Eleventh Modulator Symposium pp. 189-196 (09/1973).  
In large phased array radar systems utilizing microwave amplifier arrays connected to a common power supply, it is necessary to provide isolation between a faulted amplifier and the other amplifiers in the array. A series interrupter in the form of a high voltage fuse has been evaluated for this application. The high voltage fuse is attractive due to its low voltage drop, low cost, size and weight. A 50 kV fuse with a current rating of 4 A RMS and a current interruption time of less than 20 microseconds has been developed. This type of fuse has been found satisfactory for the majority of phased array transmitter applications. 0 Refs.  
Primary Keywords: High Voltage Fuse; Series Interrupter; Series Operation  
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3750  
(PULSE GENERATORS)  
(Reviews)  
HIGH VOLTAGE PULSE GENERATORS FOR KICKER MAGNET EXCITATION  
DC Flanders, D. Griggs, K. E. Metzmecher and P. Pearce  
CEPS, Geneva, Switzerland  
IEEE 1973 Eleventh Modulator Symposium pp. 129-137 (09/1973).  
The fast ejection facilities at the CERN 28 GeV proton synchrotron are being continually expanded to meet the increasing demand for fast ejected beams. The paper describes three new pulse generator systems for the excitation of the kicker magnets of these facilities. Firstly a pulse generator for the fast ejection from the CPS of any desired number of the twenty circulating proton bunches is treated. This equipment can perform up to six ejections per machine cycle with a minimum rise vol of 25 milliseconds. Extensive life testing of the principal elements such as thyristor switches, cable pulse forming networks and pulsed resonant power supplies is reported on. 7 Refs.  
Primary Keywords: Full Aperture Kicker; Pulse Forming Network; Thyristor; Staircase Pulse Generator  
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3751  
(SWITCHES, CLOSING)  
(Systems)  
IMPROVED MULTIGAP ELECTRONIC CROWBAR  
W. W. Schradin  
Raytheon Co., Weyland, MA 01778  
IEEE 1973 Eleventh Modulator Symposium pp. 204-206 (09/1973).  
The open-air multigap crowbar has the following characteristics: (a) rapid firing after application of the trigger pulse, (b) low voltage drop on firing, (c) low energy triggering capability, (d) large range of operating voltage under transient conditions immediately following a load arc, however, there is a danger zone of one firing voltage in which the crowbar is self-firing, thus loading the trigger voltage so that re-triggering does not occur. This paper describes a simple modification to the multigap crowbar that overcomes these conditions. (1) makes it reliably self-firing at all voltages above 20 percent of its voltage rating, (2) increases the speed of self-firing at voltages near the rated voltage, and (3) ensures that the device can be triggered when the operating voltage is below the self-firing voltage. 6 Refs.  
Primary Keywords: Pulse Forming Network; Crowbar; Wide Voltage Range; Shunt Capacitor  
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3752  
(SWITCHES, CLOSING; SWITCHES, OPENING)  
(Vacuum Tubes; Vacuum Tubes)  
LONG PULSE SWITCH AND POWER AMPLIFIER TUBES FOR PHASED ARRAY RADAR  
R.E. Byram and J.T. Mark  
RCA Corp., Lancaster, PA 17604  
IEEE 1973 Eleventh Modulator Symposium pp. 29-34 (09/1973).  
Three new tetrode tubes are now in development in 50 kW, 100 kW, and 500 kW sizes for use as long pulse radar switch tubes, and with 10 kW, 20 kW, and 40 kW levels in long pulse UHF and L-Band rf power amplifiers. All three tubes use newly developed tungsten matrix cathodes and are currently being tested for pulse lengths from 1 to 8 milliseconds and with capability for greater pulse lengths. These new cathodes are specially developed for high current long pulses, arc resistance, and long life. Aspects of the tube design and operation in typical service life test are discussed. 7 Refs.  
Primary Keywords: Tetrode Tube; Long Pulse; Tungsten-Matrix Cathode; Pulsed Emission  
Secondary Keywords: Phased Array Radar  
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3753  
(SWITCHES, CLOSING)  
(Systems)  
MULTIGAP CROWBAR TRIGGERING STUDY  
T.A. Weil  
Raytheon Co., Weyland, MA 01778  
IEEE 1973 Eleventh Modulator Symposium pp. 207-216 (09/1973).  
This paper reports the results of a study on triggering problems in the use of multigap crowbars. The validity of various crowbar test methods was studied, and recommendations will be presented. The study also determined which stray inductances and capacitances in the crowbar and its triggering circuit have a significant effect on triggering performance. Bottom triggering was studied as an alternative triggering method that provides firing under all conditions and requires no HVDC blocking capacitor. A multigap crowbar using the results of this study will be described. The crowbar includes improvements in creepage paths and in the electrode capacitor design. The crowbar is corona-free at 180 kV and is reliably self-firing above 50 kV. 8 Refs.  
Primary Keywords: Multigap Crowbar; Triggering Problems; Peaking Gap; Bottom Triggering  
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3754  
(PULSE GENERATORS)  
(Line Type)  
PULSE GROUP OPERATION OF HIGH POWER LINE TYPE MODULATORS  
R.M. Rowe  
Stanford University, Stanford, CA 94305  
IEEE 1973 Eleventh Modulator Symposium pp. 162-171 (09/1973).  
The development of a high power double pulse line type modulator is described. The design goal output of this modulator was two 185 kilovolt 2.5 microsecond pulses with an interpulse separation of 23 microseconds. In order to produce two closely spaced pulses the network of a SLAC standard 65 megawatt single pulse modulator was split electrically, but not physically. An additional hold off diode, thyatron and end of line clipper were installed thus enabling the two networks to function independently while sharing a common charging inductor and power supply. The interaction problems, i.e., sympathetic firing, etc. encountered and the methods used to solve them are discussed. 0 Refs.  
Primary Keywords: Line Type Modulator; Double Pulsed Operation; End-of-line Clipper; Pulse Transformer; Thyatron  
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3755  
(PULSE GENERATORS)  
(Hard-tube)  
QUENCH MODULATOR FOR COLD-CATHODE CROSSED-FIELD AMPLIFIER  
W.I. Smith  
RCA Corp., Moorestown, NJ 08057  
IEEE 1973 Eleventh Modulator Symposium pp. 153-155 (09/1973).  
A radar transmitter designed by the Missile and Surface Radar Division of RCA has achieved versatile performance through use of a type SFQ-257 crossed-field amplifier. This CFA features a cold cathode whose emission is initiated by RF drive and terminated by a hard-tube modulator-driven electrode. The performance and design features of the transmitter are described, with emphasis on the specialized pulse shaping and hard-tube modulator required by the quench electrode. 0 Refs.  
Primary Keywords: Hard-tube Pulse Generator; Quench Modulator; Crossed-Field Amplifier; Variable Power; Variable Repetition  
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3756  
(SWITCHES, CLOSING)  
(Systems)  
RAPID RECYCLE CROWBAR CIRCUITS  
G.R. Lyuta and T.A. Weil  
Raytheon Co., Weyland, MA 01778  
IEEE 1973 Eleventh Modulator Symposium pp. 217-226 (09/1973).  
Crowbar circuits are used across high voltage energy storage capacitors employed in the output stages of high power radar transmitters. Conventional high voltage power supply and crowbar systems require OFF-ON recycle times in the order of seconds. Circuits were studied which will allow the radar transmitter to be brought back to operation within a few hundred microseconds after a tube fault condition. Two basic circuits were tested. In the first kind of circuit, the capacitor bank energy is dissipated, as in conventional crowbar circuits, and the bank is then quickly recharged from another capacitor. In the second kind of circuit, the energy in the capacitor bank is temporarily stored in reversed polarity on the same capacitor, and then returned to normal polarity to restore operation. The tests showed that both kinds of circuits worked, with a preference for the second kind described above. Further work is needed on switching devices for this application, and it remains to be determined how fast voltage may actually be reapplied to an RF tube after an arc without causing it to arc again. 7 Refs.  
Primary Keywords: Crowbar Circuit; Rapid Recycling; Triggered Vacuum Gap; Triggered Gas Gap; Short Recovery Time  
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1757  
(PULSE GENERATORS; SWITCHES, CLOSING)  
(Line Type; Thyristors)  
SOLID-STATE MODULATOR TECHNIQUES TO PROMOTE FAST PULSE FALL TIMES  
V.M. Martin  
Raytheon Co., Waltham, MA  
IEEE 1973 Eleventh Modulator Symposium pp. 89-94 (09/1973).  
This paper describes solid-state tail-biter switching circuitry for grid drive tail-biters in hard-tube modulators and tail-biters employed in high pulse repetition rate line-type modulators used in short range search and mapping radars. Tail-biter circuits are most advantageous in producing fast fall times in the video pulses used to drive high power amplifiers. This paper describes the use of SCRs in tail-biter circuits that overcome d/dt limitations which formerly precluded their use in such applications. Results of laboratory experimentation and actual circuit implementation in production systems are described. 3 Refs.  
Primary Keywords: Tail-biter Circuit; Thyristors; Transistors; Fast Fall Time  
Secondary Keywords: Hard-tube Pulsers; Line Type Modulator  
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3758  
(SWITCHES, CLOSING; SWITCHES, OPENING)  
(Gas Gaps; Crossed-field; Gas Gaps; Crossed-field)  
THE CROSSED FIELD SWITCH TUBE AND ITS APPLICATION TO HIGH POWER MODULATORS  
M.A. Lutz  
Hughes Research Labs., Malibu, CA 90265  
IEEE 1973 Eleventh Modulator Symposium pp. 40-46 (09/1973).  
This paper describes the principles and recent development of a crossed field switch tube capable of closing and opening an HVDC circuit. The tube operates as a Penning discharge which can be controlled by an externally applied magnetic field. Several of the physical phenomena associated with this tube are described, including ignition jitter, the glow to arc transition, sputtering, gas clean-up and life. One particular tube has reliably interrupted 2.5 kA against 60 kV with a voltage recovery rate of 15 kV/microsecond. Several applications for this tube are described besides those relating to power utility service. These include component protection, HVDC interruption for current-fed line-type modulators and substitution for hard vacuum tubes for higher power hard tube modulators. 12 Refs.  
Primary Keywords: Crossed Field Switch Tube; HVDC Circuit; Penning Discharge; Jitter; Glow-to-Arc Transition; Life Test  
Secondary Keywords: Hard Tube Modulator  
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3759  
(SWITCHES, CLOSING)  
(Thyristors)  
THE DEVELOPMENT OF DEUTERIUM THYRATRONS FOR OPERATION AT HIGH DUTY-RATIOS AND HIGH AVERAGE CURRENTS  
R.J. Wheldon (1) and N.S. Nicholls (2)  
(1) MD Valve Co., London, UK  
(2) Royal Radar Establishment, Malvern, Worcestershire, UK  
IEEE 1973 Eleventh Modulator Symposium pp. 239-241 (09/1973).  
A circuit is described in which thytrons have been operated at 52% duty-ratio with unusually high average current. Two valve types are described which have been developed to give long lives in this class of service. Good inverse-voltage performance and instant start capability at full power were also necessary. 4 Refs.  
Primary Keywords: Deuterium Thytrons; High Average Current; High Speed  
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3760  
THE GENERATION OF HIGH FREQUENCY SINUSOIDAL AND PULSE WAVEFORMS USING HYDROGEN THYRATRONS  
L.J. Kettle and B.P. Newton  
English Electric Valve Co Ltd, Chelmsford, Essex, UK  
IEEE 1973 Eleventh Modulator Symposium pp. 150-152 (09/1973).  
The circuit of a high efficiency, high frequency sine-wave generator using a hydrogen thyatron switch is described and some of its uses are mentioned. Further, a combination of this circuit with a standard pulse modulator circuit enables a high frequency pulse generator to be built which allows a longer than normal recovery period for the thyatron. 0 Refs.  
Primary Keywords: Pulse Generator; Waveform Generator; Hydrogen Thyatron; Long Recovery Period  
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3761  
(SWITCHES, CLOSING)  
(Thyristors)  
THYRISTORS FOR PULSE MODULATION AT HIGH PEAK AND AVERAGE POWERS  
D.E. Gross (1), N.S. Nicholls (2) and F. Wood (2)  
(1) Hirst Research Labs, Wembley, UK  
(2) Royal Radar Establishment, Malvern, Worcestershire, UK  
IEEE 1973 Eleventh Modulator Symposium pp. 12-16 (09/1973).  
The design problems of a large pulse modulator thyristor for 2 KV 1 KA operation at 30 microsecond pulse length are discussed, and experimental devices are described. The performance obtained is compared with that of possible alternative devices, both solid-state and gas discharge. 1 Refs.  
Primary Keywords: Thyristor Modulator; Experimental Device; Design Problems; High Current; High Speed  
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3762  
(PULSE GENERATORS)  
(Hard-tube)  
TRADEX S-BAND TRANSMITTER MODULATOR  
R.M. Casolare  
RCA Corp., Moorestown, NJ 08057  
IEEE 1973 Eleventh Modulator Symposium pp. 61-67 (09/1973).  
The TRADEX S-Band transmitter modulator is a direct series-coupled floating-deck modulator employing three L5097 Beam Switch Tubes in a parallel connection as the main switch device. The modulator normally operates at a full peak-power level of 15 megawatts and a duty of 0.03 and delivers a -120 kV, 125-ampere pulse to a VK58250 klystron beam. The modulator can generate a wide range of single-pulse or burst-mode waveforms at various PRFs and allows for continuous changing of waveform during a mission without interruption of data. The constant current characteristic of the BSI provides flat-top pulses, inherent regulation features and fault current limiting. 0 Refs.  
Primary Keywords: Beam Switch Tube; Parallel Switch Tubes; Variable Pulse Width  
Secondary Keywords: Klystron Modulator  
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3743  
(ENERGY CONVERSION, ELECTRICAL)  
(Charging Circuits)  
TRIGGERED CHARGING TECHNIQUES FOR PULSE GENERATING CIRCUITS  
G. J. Scoles  
English Electric Valve Co Ltd, Chelmsford, Essex, UK  
IEEE 1973 Eleventh Modulator Symposium pp. 172-174 (09/1973).  
This paper describes several different circuits which can be used to obtain reliable triggered charging. For hydrogen thyratron modulators with duty cycles in excess of 0.001 it is usually necessary to delay the recharging of the pulse forming network to allow time for switch tube recovery. 0 Refs.  
Primary Keywords: Charging Circuit; Command Charging; High Duty Factor  
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3744  
(SWITCHES, CLOSING; SWITCHES, OPENING)  
(Vacuum Tubes; Vacuum Tubes)  
4CW100,000 TETRODE PULSE TESTS AT RADC  
P. Bryan and H. Beard  
RADC, Griffiss AFB, NY 13440  
IEEE 1973 Eleventh Modulator Symposium pp. 35-39 (09/1973).  
This investigation showed that this tube can provide very stable pulse performance at a wide variety of conditions well above its 4 megawatt and 40 kV ratings. In an effort to obtain data beyond the published ratings on Tetrode Switch Tubes, the RADC High Power Laboratory conducted an investigation on three versions of the EIMAC 4CW100,000 Tetrodes. These tubes are manufactured for high power short-wave broadcast service. 0 Refs.  
Primary Keywords: 4CW100,000 Tetrode; Rise Time Determination; Voltage Drop; Anode Discharge; High Voltage; High Power  
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3745  
(PULSE GENERATORS)  
(Hard-tube)  
600 KW PEAK HIGH REPETITION RATE HARD TUBE MODULATOR  
R. A. Ecken and L. Genova  
Stanford University, Stanford, CA 94305  
IEEE 1973 Eleventh Modulator Symposium pp. 47-55 (09/1973).  
This paper describes the design, fabrication and test results of a modulator for the 220 kW S-Band Klystrons which are part of the proposed beam recirculating system at the Stanford Linear Accelerator Center. 0 Refs.  
Primary Keywords: Hard-Tube Pulsers; Series Modulator; High Rep-Rate  
Secondary Keywords: Klystron Driver  
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3746  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
EXPERIMENTAL INVESTIGATION OF THE STABILITY CONDITIONS OF A DISCHARGE IN A GAS STREAM  
G. A. Galachyan and S. I. Petrosyan  
Institute Of Physics Research, Academy of Sciences of the Armenian SSR, Yerevan  
Sov. J. Quantum Electron., Vol. 7, No. 5 pp. 649-650 (05/1977).  
Trans. From: Kvantovaya Elektronika, 1143-1144 (January 1977).  
It is shown that the flow of a gas through a discharge region gives rise to fluctuation of the current and the amplitude of these fluctuations depend on the gas pressure and flow rate. The conditions for stability of a discharge in a flowing gas are determined. 2 Refs.  
Primary Keywords: Electrical Discharge; Flowing Gas; Discharge Stability; Variation With Pressure  
Secondary Keywords: Laser Pumping  
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3748  
(REVIEWS AND CONFERENCES)  
(Reviews)  
GENERAL CONSIDERATION OF ENERGY COMPRESSION  
D. S. Zucker  
Lawrence Livermore Lab, Livermore, CA 94550  
LLL Report No. UCRL-80047 (10/1977).  
Availability: UCRL-80047  
NTIS  
This general treatment of energy compression deals with some of the fundamental considerations involved in such a process. The authors discuss: 1) the need for complementary energy modes such as magnetic electric or kinetic energy modes among which to transfer the energy from one to another; 2) the difference between longitudinal and transverse compression where the former shortens the pulse length and the latter the pulse width; 3) the adiabatic vs. the nonadiabatic process and the need for coherence; 4) the maximum efficiency path and optimum number of stages to achieve a given compression; 5) the generalized action equation of compression. A variety of compression circuits will be discussed utilizing some of the above mentioned principles. 0 Refs.  
Primary Keywords: Energy Compression; Impedance Conversion; Plasma State

3749  
(SWITCHES, CLOSING)  
(Miscellaneous)  
LIGHT ACTIVATED SEMICONDUCTOR SWITCHES  
D. S. Zucker  
Lawrence Livermore Lab, Livermore, CA 94550  
LLL Report No. UCRL-80046 (10/1977).  
Availability: UCRL-80046  
NTIS  
Semiconductor junctions are capable of switching large power densities. As far back as the early 60's, silicon thyristors conducted 10 kA/cm<sup>2</sup> in the surge mode. Electric fields approaching 100 kV/cm are quite common. The single obstacle in the utilization of these devices in high power applications is the slow current rate of rise, and high power operation was attained in millisecond type applications only. The slow turn-on is due to the slow diffusion of carriers in the absence of an electric field limiting these devices to the microsecond rise time regime. Light activation which involves flooding the depletion region with laser light provides for instantaneous conduction by creating the electron hole pairs necessary for conduction in situ. This paper will discuss the potentialities—both theoretical and practical—for the utilization of these devices in high-power applications. In addition, some circuiting potentialities and some techniques to improve the performance and new materials. 0 Refs.  
Primary Keywords: Light Activated Semiconductor Switches; Resonance Effects

3771  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
PULSED NANOSECOND ELECTRIC DISCHARGES IN GASES  
G. A. Mesyats, Y. I. Bychkov and V. V. Kramov  
Academy of Sciences of the USSR, Tomsk, USSR  
Sov. Phys. Usp. Vol. 15, No. 3 pp. 282-297 (12/1972).  
Trans. From: Usp. Fiz. Nauk 107, 201-228 (June 1972).  
We analyze the physical phenomena occurring during the breakdown of gas gaps within times on the order of several nanoseconds or less. It is noted that the streamer mechanism has low probability if the times of formation of the discharge and the fall-off of the voltage across the gap are commensurate with the emission times of the excited molecules. The development of a Townsend discharge is made difficult by the strong influence of the space charge of the avalanche. The discharge mechanisms in single-electron and multi-electron initiation are described and the features of their development are outlined. Oscillographic and electron-optical measurement procedures are described and the main experimental results are reported. Theories explaining the main regularities are presented together with the mechanism for initiation and development of a discharge in uniform electric fields. It is noted that x-radiation is produced in the discharge. Results are reported on a discharge at a voltage below the static breakdown value, initiated by fast electrons and by intense ultraviolet radiation. 66 Refs.  
Primary Keywords: Nanosecond Breakdown; Single-electron Initiation; Multi-electron Initiation; Townsend Discharge; Very Strong Electric Fields  
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3772  
(SWITCHES, OPENING)  
(Gas Gaps, C-beam)  
RAPID CUTOFF OF A HIGH CURRENT IN AN ELECTRON-BEAM-EXCITED DISCHARGE  
B. M. Kovalevichuk and G. A. Mesyats  
Institute Of Atmospheric Optics, Academy of Sciences of the USSR, Moscow, USSR  
Soviet Technical Physics Letters, Vol. 2, No. 7, pp. 252-25 (07/1976).  
Trans. From: Fizika Plazmy, 12, 644-648 (1976).  
The problem of cutting off a high current like 1E5-1E6 A in a time interval of the order of 1E7 sec is a central problem in the development of high-power nanosecond pulse systems with inductive energy storage. Apparently the only known current breaker capable of handling high-power, nanosecond pulses in inductive energy storage systems is a device which exploits the explosion of a large number of micron-size conductors. These breakers are single-shot devices, so that their application is limited. We believe that devices with externally sustained volume gas discharges, controlled by electron beams, are promising for use in high-current current breakers. In such a device, which we call an "injection thyratron", the current is cut off by terminating the injection of electrons into the gas. 5 Refs.  
Primary Keywords: E-beam Controlled Opening Switch; Injection Thyratron; Analysis; Theory  
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3774  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES)  
(Gas, Optical; Lightning)  
A PRELIMINARY STUDY OF AEROSOL INITIATED CO/SUB 2/ LASER PRODUCED AIR SPARKS AND THEIR ABILITY TO GUIDE ELECTRICAL DISCHARGES  
J. R. Greig, R. E. Pachacek, R. F. Fernsler, I. M. Vitkovitsky, A. W. Desliva and D. W. Koppman  
Naval Research Lab, Washington, DC 20375  
NRL Memorandum Report No. 3647 (11/1977).  
Availability: AD A050097  
NTIS  
The time development of air sparks initiated on aerosols near the focal region (3m) of a 1 kJ CO/sub 2/ laser beam has been studied. The spark at each aerosol produced a shock wave that expanded spherically at approximately 2E5 cm/sec during the 1.5 microsecond tail of the laser pulse. In time these spherical waves coalesced forming a turbulent cylindrical column from which a cylindrical blast wave separated. The turbulent cylindrical region was nearly stationary (> 100 microsecond time scale) and was able to conduct electrical streamers at greatly enhanced velocities at times as long as one millisecond after the laser pulse. 19 Refs.  
Primary Keywords: High Power; Aerosol; Air Breakdown; Electrical Discharge Guiding  
Secondary Keywords: Gas Laser

3778  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
CRITERIA FOR SPARK BREAKDOWN IN SULFUR HEXAFLUORIDE  
A. Pedersen  
The Technical University, Lyngby, Denmark  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-89, No. 8, pp. 2043-2048 (12/1970).  
Possible mechanisms of spark breakdown in SF/sub 6/ and other electronegative gases are discussed, and quantitative criteria are derived for the Townsend type and the streamer type of breakdown in nonuniform fields. The Townsend criterion is of considerable physical interest but difficult to apply to engineering problems, whereas the semi-empirical streamer criterion, which holds for impulse breakdown, can be applied to any gap geometry of known field distribution. 23 Refs.  
Primary Keywords: SF/sub 6/; Breakdown Mechanism; Townsend Discharge; Streamer Mechanism; Field Distribution  
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3789  
(SWITCHES, CLOSING)  
(Solid Dielectric, Electrical)  
HIGH-PRECISION FAST-ACTING DISCHARGER WITH A SOLID DIELECTRIC  
A. B. Gnaniyur, L. V. Dubovoy and G. R. Galitskiy  
Scientific-Research Institute Of Electro-Physical Apparatus, Leningrad, USSR  
Instruments And Experimental Techniques, No. 2, pp. 446-448 (04/1970).  
Trans. From: Pribury i Tekhnika Eksperimenta 2, 120-122 (March-April 1970).  
A discharger with polyethylene insulation for the spark gap is described. The discharger inductance is less than 1 cm, it operates in the 30-5E4 V voltage range, and the firing time is about 3E-7 sec. 7 Refs.  
Primary Keywords: Solid Dielectric Switch; Polyethylene Dielectric; 30-5E4 V Operating Voltage; Low Inductance  
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3806  
(POWER CONDITIONING; POWER CONDITIONING)  
(Peaking Gaps; Sparkable Reactors)  
PEAKING THE TRAILING EDGE OF A HIGH-VOLTAGE NANOSECOND PULSE IN AN UNMATCHED LOAD  
D.G. Il'in and A.M. Shenderovich  
Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Kharkov, USSR  
Instruments And Experimental Techniques, No. 2, pp 440-442 (04/1970).  
Trans. From: Priroda i Tekhnika Eksperimenta 2, 116-118 (March-April 1970)  
Methods of peaking the trailing edge of high-voltage pulses by means of spark gaps and nonlinear inductances are described. Oscillograms of the pulses are given. From the results obtained it follows, in particular, that the methods suggested can be used to obtain durations of 1 to 2 nsec for both the leading and trailing edges of a pulse in an unmatched load. 5 Refs.  
Primary Keywords: Pulse Trailing Edge; Edge Sharpening; Trigonon Spark Gap; Nonlinear Inductance; Unmatched Load  
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3812  
(PULSE GENERATORS)  
(Reviews)  
BE KIND TO YOUR PULSE GENERATOR  
M. Marshall  
E-H Research Labs, Oakland, CA 94607  
Electronic Design, Vol. 1, pp 34-38 (01/1975).  
Problems frequently encountered by pulse generator users, such as improper termination and missing pulses, are examined as are their solutions. Selecting the right generator for different applications and the trade-offs to watch out for are discussed. 0 Refs.  
Primary Keywords: Proper Pulse Generator Application; Reading Specifications; Care With Cabling  
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3822  
(DIAGNOSTICS AND INSTRUMENTATION)  
(B-field)  
ALTERNATING MAGNETIC-FIELD INDUCTION METER UTILIZING THE HALL EFFECT  
I.L. Vinnikov and V.I. Katamadze  
Institute Of Electronics, Automation, And Remote Control, Academy of Sciences of the Georgian SSR, Tbilisi, USSR  
Instruments And Experimental Techniques, No. 5, pp 1221-1224 (10/1969).  
Trans. From: Priroda i Tekhnika Eksperimenta 5, 116-119 (September-October 1969)  
An instrument is described for measuring average values of the alternating component of magnetic field induction in air gaps of 1 mm or more at frequencies from 20 Hz up to 10 kHz. Within the range from 0.001 to 1.0 T, with an accuracy better than  $\pm 2.5\%$ . The response of the induction pickup (an indium arsenide-phosphide Hall generator) is linearized over each measuring range. The variations of the induction curve can be observed on an electronic oscilloscope for which connections are provided. The induction meter has been calibrated with known values of constant magnetic field induction. 4 Refs.  
Primary Keywords: Hall Effect Sensor; 0.001-1.0 T Field Range; 20 Hz-10 kHz Frequency Range; Error Analysis  
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3838  
(PULSE GENERATORS)  
(Trigger)  
FOUR-CHANNEL UNIT FOR FIRING SPARK GAPS SYNCHRONOUSLY  
V.M. Rybin, V.N. Cherepanov, M.I. Zinchenko and V.A. Stepanov  
Sukhumi Physicotechnical Institute, Sukhumi, USSR  
Instruments And Experimental Techniques, No. 5, pp 1187-1188 (10/1969).  
Trans. From: Priroda i Tekhnika Eksperimenta 5, 86-87 (September-October 1969)  
A simple circuit is described for a four-channel synchronous spark-gap firing unit with an independent power supply based on a pulsed rectifier. The device was tested on a modulator at a working voltage of 50 kV. The dispersion in the firing was no more than 50 nsec. 4 Refs.  
Primary Keywords: Trigger Generator; Thyatron; Capacitor Energy Storage; 45 kV Output Voltage; 50 ns Jitter; Pulse Transformer  
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3840  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
HIGH-VOLTAGE GAS-FILLED SPARK GAP  
V.M. Ishchenko and V.N. Starinskii  
Institute Of Semiconductor Physics, Academy of Sciences of the USSR, Novosibirsk, USSR  
Instruments And Experimental Techniques, No. 5, pp 1185-1186 (10/1969).  
Trans. From: Priroda i Tekhnika Eksperimenta 5, 85-86 (September-October 1969)  
A gas-filled spark gap and the results of its electrical tests are described. The spark gap is designed to switch coaxial cables that are charged up to voltages between 10 and 40 kV. 1 Refs.  
Primary Keywords: Spark Gap; Field Distortion Gap; Nitrogen Gap; 40 kV Operating Voltage; Breakdown Voltage Measurement; Switching Line Measurement; Rep-rated; 1 Hz Repetition Rate  
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3843  
(POWER CONDITIONING)  
(Pulse Transformer)  
INCREASING THE MAXIMUM GRADIENTS IN THE WINDINGS OF THE PULSE TRANSFORMERS OF ACCELERATOR FOREINJECTORS  
A.I. Babelin, G.R. Zabitshvaya, I.M. Roife and S.P. Yakovlev  
Instruments And Experimental Techniques, No. 4, pp 911-915 (07/1969).  
Trans. From: Priroda i Tekhnika Eksperimenta 4, 94-98 (July-August 1969)  
The present article describes the results of an investigation of the maximum electric field gradients in the winding insulation of the pulse transformers used for the high-voltage supply of accelerator tubes in high-power accelerators. An increase in the capacitive load leads to an increase in the maximum gradients. 1 Refs.  
Primary Keywords: Pulse Transformer; Voltage Distribution; Low Current; Capacitive Load; Performance Test  
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3855  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES)  
(Gas, Electrical; Gas, Optical)  
PROPAGATION OF HIGH-VOLTAGE STREAMERS ALONG LASER-INDUCED IONIZATION TRAILS  
J.R. Vaill, D.A. Tidman, T.D. Wilkerson and D.W. Koopman  
Versar Inc, Alexandria, VA 22314  
Applied Physics Letters, Vol. 17, No. 1, pp 20-22 (07/1970).  
The channeling and guidance of an electrical breakdown streamer via a laser-induced ionization trail is discussed, and preliminary experiments demonstrating this phenomenon are reported. 15 Refs.  
Primary Keywords: Breakdown Channeling; Laser Channeling; Theory; Geometry Considerations  
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3861  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
SUBNANOSECOND-JITTER LASER-TRIGGERED SWITCHING AT MODERATE REPETITION RATES  
J.R. Bettis and A.H. Guenther  
AFWL, Kirtland AFB, NM 87117  
IEEE Journal Of Quantum Electronics, Vol. QE-6, No. 8, pp 483-491 (08/1970).  
A 50-kV laser-triggered spark gap operated at repetition rates to 50 pps is described. Jitter of delay time as low as  $\pm 0.1$  ns was demonstrated. Dependence of delay and jitter was investigated as a function of gas mixture, pressure, laser power, and electrode material. Subnanosecond jitter was obtained with as little as 0.17 mJ in a 6-nsec pulse from a Nd:sup 43/ in a YAG laser. The dielectric gases used included a high proportion of Ar mixed with N/sub 2/ or SF/sub 6/. 16 Refs.  
Primary Keywords: Nd-YAG Laser; Argon Gaps; Various Electrode Materials; Subnanosecond Jitter; Rep-rated; Life Test  
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3888  
(DIAGNOSTICS AND INSTRUMENTATION; DIAGNOSTICS AND INSTRUMENTATION)  
(Current; Voltage)  
HIGH-IMPULSE CURRENT AND VOLTAGE MEASUREMENT  
R.J. Thomas  
Lawrence Livermore Lab, Livermore, CA 94550  
IEEE Transactions On Instruments And Measurement, Vol. IM-19, No. 2, pp 102-117 (05/1970).  
This paper is a survey of methods of high-impulse current and voltage measurements. Typically, such measurement techniques must now include capabilities for measuring high-energy impulses having peak powers as high as many megawatts, currents as high as many megamperes, or voltages as high as several megavolts, with rise times as short as a fraction of a microsecond (even as short as the subnanosecond range for moderately high-energy impulses). These capabilities had to be attained in recent years to meet the needs of various areas of scientific research employing such high-energy impulses. This represents a significant extension in the state of the art of such measurement techniques beyond their more traditional role in development and testing of high-voltage bulk power system equipment. The three most commonly used methods of high-impulse current measurement are the magnetic probe, current transformer, and 'pure' resistive shunt methods. These methods are treated in considerable detail. High-voltage capacitive dividers, resistive dividers, and reflection-type attenuators are covered as the principal methods of high-impulse voltage measurement, with some added discussion of the means of insulating such devices. 41 Refs.  
Primary Keywords: Review; Magnetic Probe; Shunt; Capacitive Divider; Resistive Divider; Reflection-type Attenuator  
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3907  
(INSULATION, MATERIAL)  
(Reviews)  
SELECTION OF MATERIALS FOR USE AS ELECTRICAL INSULATION-A PHILOSOPHICAL AND SYSTEMATIC APPROACH  
J.R. Perkins  
DuPont Co, Wilmington, DE 19898  
IEEE Transactions On Electrical Insulation, Vol. EI-6, No. 3, pp 106-110 (09/1971).  
The selection of a material for use can be simplified by listing the user requirements/material-properties systematically so that a workable combination of properties can be found. The requirements are organized under the headings of mechanical, thermal, environmental, electrical, and economic. These are generally in decreasing order of importance except where economic factors override. 0 Refs.  
Primary Keywords: Insulation; Selection Criteria; Mechanical; Thermal; Environmental; Electrical; Economic  
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3920  
(SWITCHES, CLOSING)  
(Gas Gaps, Optical)  
TRIGGERING OF SPARK GAPS BY LASER-INDUCED ION EMISSION  
K. Ujihara and M. Kamiyama  
University of Tokyo, Bunkyo-ku, Tokyo, Japan  
IEEE Journal Of Quantum Electronics, Vol. QE-6, No. 4, pp 239-241 (04/1970).  
A mechanism of laser triggering of spark gaps in which laser-produced ions play the dominant role is investigated for several electrode materials. Spark channels due mainly to laser-produced electrons and channels due mainly to laser-produced ions are clearly distinguished by high-speed shadowgraph techniques. 10 Refs.  
Primary Keywords: Laser-produced Ions; Several Electrode Materials; Long Delay Times; Anode Irradiation; Ruby Laser  
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3927  
(BREAKDOWN STUDIES)  
(Gas, Particle)  
STUDY OF THE EFFECT OF DUST PARTICLES ON BREAKDOWN VOLTAGES IN AIR  
K.H.H. Martinussen and G.R. Bozzoli  
The Transactions Of The South African Institute Of Electrical Engineers, Vol. 55, Part 4, pp 133-141 (04/1964).  
The results of a study of the influence of carbon and silica dust in a sphere-sphere air gap is presented in this paper. It was found that the dust deposited on the cathode was the major contributor to the reduction of breakdown voltage and that dust concentration in the gap has negligible effect. The Fowler-Nordheim equation is used to show that the increase in the case from a theoretical approach. 9 Refs.  
Primary Keywords: Air Breakdown; Sphere-sphere Gaps; Dust Particles; Carbon; Silica; Cathode Effects  
COPYRIGHT: 1964 THE SOUTH AFRICAN INSTITUTE OF ELECTRICAL ENGINEERS



Primary Keywords: Pulse Transformers; High Energy; Tesla Transformer;  
High Efficiency  
COPYRIGHT: 1978 THE INSTITUTE OF PHYSICS

3982  
BREAKDOWN MECHANISM OF LASER-TRIGGERED SPARK GAP IN NONUNIFORM FIELD 1.  
TRIGGER EFFECT AND TIME-LAG CHARACTERISTICS

COPYRIGHT: 1962 THE INSTITUTE OF PHYSICS, REPRINTED WITH PERMISSION

Primary Keywords: Picture Frame Magnet; 90 ns Rise Time; 3600 A  
Current; Thyatron; Pulse Forming Line; Rep-rated  
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A method of measuring prebreakdown currents in a vacuum gap is described in this paper. A precision transformer is used to sample input voltage, which can then be used to compensate for displacement current in the gap. Currents as low as 0.1 microamp have been measured. A sample Fowler-Nordheim Plot is included. 2 Refs.

Primary Keywords: Frabreakdown Current; Vacuum Gap; Compensating Transformer; Fowler-Nordheim Plot

COPYRIGHT: 1976 IFF

Primary Keywords: Self-break Spark Gap; Resistance Measurement; Temporal Resolution; Nitrogen Gap; Helium Gap; Current Rise Time; Microprobe Diagnostic

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the electron beam spread. The results obtained  
for the electron beam spread are in the range of  
0.1 to 0.2 mm for the electron beam spread. R  
0.1 to 0.2 mm for the electron beam spread.

Primary Keywords: Microparticle; Dielectric; Conducting; Effect On Breakdown; Voltage; Conditioning; Stainless Steel Electrode

COPYRIGHT: 1974 THE AMERICAN VACUUM SOCIETY

Primary Keywords: Silicon Diode; High-voltage Diode; Breakdown;  
Absolute Resistivity; Variation In Resistivity  
COPYRIGHT: 1975 THE ELECTRO CHEMICAL SOCIETY, INC.

SPHERE GAP; TOEPLER DISCONTINUITY; BREAKDOWN VOL  
SCATTER  
COPYRIGHT: 1967 IEEE. REPRINTED WITH PERMISSION

Primary Keywords: Low-pressure Discharge; Collisionless Plasma-sheath Equations; Floating Wall Potential; Ion Generation; Electron Distribution Function

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The elimination of late-time plasma closure in the diode gap is demonstrated. Due to these characteristics, a significant reduction in the time-averaged diode impedance and an improvement in the pulse-line-diode energy transfer efficiency has been obtained thus permitting first observations of efficient matching to a sub-ohm

Primary Keywords: E-beam Generation; Field Emission Diode; Magnetron; Field; Converging Gradient; Diode Impedance Reduction

4057  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
(Static and Dynamic Properties of Arcs Near Plane Surfaces)  
E. J. Los (1) and DC Jolly (2)  
(1) General Electric Co., Pittsfield, MA 01201  
(2) Massachusetts Institute of Technology, Cambridge, MA  
Z. Physik, Vol. 20, pp 3-11 (01/1975).  
The static and transient behavior of arcs near plane surfaces are analyzed theoretically, and the models obtained are compared with empirical data. The linearization technique of Maescker was used to predict the static properties of the arcs and showed fair agreement with test results when the surface was dry, but was off when the surface was wet. Phillips' model was used to analyze the dynamic behavior of the arcs, and as before the dry surface results agreed with theory, but wet surface results did not. 22 Refs.  
Primary Keywords: Dielectric Surface; Dry Surface; Wet Surface; Experiment; Theory; Maescker's Method; Phillips' Method.

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4067  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
(A 100 KV, FAST, HIGH ENERGY, NONUNIFORM FIELD DISTORTION SWITCH)  
R. S. Post and Y. G. Chen  
Columbia University, New York, NY 10027  
The Review Of Scientific Instruments, Vol. 43, No. 4, pp 622-624 (04/1972).  
A fast closing, high voltage, high energy, nonuniform field distortion switch has been developed. This switch, filled with free-flowing one atmospheric sulfur-hexafluoride gas, operates in the cascade mode, and is able to handle 36 kJ at 85 kV. These switches have been tested and put into operation with the Columbia high voltage capacitor bank. The over-all jitter between the six switches used is less than 10 nsec at 85 kV. 4 Refs.  
Primary Keywords: Field Distortion Gap; SF/sub 6/ Gap; Atmospheric Pressure; Flowing Gas; 85 kV Operating Voltage; 10 ns Jitter

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4068  
(ENERGY STORAGE, CAPACITIVE)  
(Capacitors)  
(CERAMIC HIGH-VOLTAGE CAPACITORS K-15U-1, K-15U-2, AND K-15U-3)  
N. V. Stavitskaya (Ed.) and S. Y. Baban (Ed.)  
FSTC Report No. FSTC-MT-23-762-68 (05/1969).  
Trans. From: Handbook Published By The Standards Publishing House, USSR (1967)  
Availability: AD 687317  
NTIS

This report is a translation of a Soviet standard concerning ceramic capacitor fabrication. The present standard applies to capacitors of fixed capacitance having a ceramic dielectric, designed for operation in direct current circuits with a voltage up to 30 kV, in high frequency alternating current circuits with a voltage up to 25 kV rms and in pulse modes. 0 Refs.  
Primary Keywords: Ceramic Capacitor; High Voltage; Standard Of Fabrication; Application Data

4069  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
(CROWBARRING TECHNIQUE FOR HIGH-VOLTAGE CAPACITOR BANKS)  
M. K. Tucker  
Sandia Labs, Albuquerque, NM 87115  
(08/1971).  
Availability: SC-DR-710154  
NTIS

For abstract, see NSA 25 17, number 41665.  
Primary Keywords: Electric Capacitors

4070  
(PULSE GENERATORS)  
(Capacitor Banks)  
(CURRENT SHAPING TECHNIQUES FOR HIGH-VOLTAGE CAPACITOR BANKS)  
M. K. Tucker  
Sandia Labs, Albuquerque, NM 87115  
(08/1971).  
Availability: SC-DR-710463  
NTIS

For abstract, see NSA 25 23, number 57268.  
Primary Keywords: Electric Capacitors

4071  
(ENERGY STORAGE, CAPACITIVE)  
(Capacitor Banks)  
(DESIGN AND CONSTRUCTION OF FAST HIGH ENERGY, HIGH VOLTAGE CAPACITOR BANKS)  
M. Hess  
Lawrence Livermore Lab, Livermore, CA 94550  
(06/1969).  
Availability: UCID-16166  
NTIS

For abstract, see NSA 27 11, number 26591.  
Primary Keywords: Electric Capacitors  
Secondary Keywords: AEF

4073  
(POWER CONDITIONING)  
(Pulse Forming Networks)  
(DIGITAL SIMULATION AND PARAMETER ESTIMATION TECHNIQUES FOR THE E-LINE PULSE-FORMING NETWORK)  
L. W. Vannoy  
AFIT, Wright-Patterson AFB, OH  
AFIT Report No. AFIT/GE/EE/79-2 (03/1979).  
Availability: AD A069199  
NTIS

A line-type, voltage-fed, pulse-forming network, called the 'E-line', is studied. The energy to be delivered to the load is stored in a source capacitor at the front of the network. Storing all the energy in the source capacitor leads to a more reliable and lightweight system than is achievable by a conventional network where all the capacitors store energy. The network is to deliver 100-200 rectangular pulses per second to the load where each pulse is 20-30 microseconds in duration and has a pulse height of 30,000 volts. A computer program is developed which models the discharge of the network and is used to analyze the output pulse shape for different inductor and capacitor values within the network. Another computer program is developed which estimates the inductor and capacitor values needed for the network to give a close approximation to the desired rectangular pulse. 8 Refs.  
Primary Keywords: E-line Pulse Forming Line; Simulation; State-variable Model; Design Considerations; Numerical Calculation

4074  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
(CURRENT FLOW IN A HIGH-VOLTAGE DIODE SUBJECTED TO A CROSSED MAGNETIC FIELD)  
T. J. Orzechowski and G. Bekefi  
Massachusetts Institute of Technology, Cambridge, MA  
The Physics Of Fluids, Vol. 19, No. 1, pp 43-51 (01/1976).

The space-charge limited electron current (approximately 50 kA) flowing in a pulsed, high voltage (approximately 200 kV) vacuum diode is studied as a function of magnetic field applied at right angles to the diode electric field. The observations compare favorably with predictions from self-consistent theory which takes account of space-charge and allows for the presence of the magnetic field. Time-resolved measurements of the diode current and voltage lead to a determination of the expansion velocity of the cathode and anode plasmas. It is shown that a magnetic field of approximately 5 kG suffices to stop plasma motion, in agreement with magnetohydrodynamic computations. Thus, diode closure is inhibited, at least over the 40 nsec time span of the voltage pulse. 39 Refs.  
Primary Keywords: E-beam Generation; Field Emission Diode; Transverse Magnetic Field; Electron Current Flow; Cylindrical Diode; Graphite Cathode

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4075  
(REVIEWS AND CONFERENCES; PULSE GENERATORS)  
(Reviews; Reviews)  
(FORMATION OF NANOSECOND PULSES OF HIGH VOLTAGE)  
G. A. Mesyats, A. S. Nasibor and V. V. Kremnev  
FID Report No. FID-MC-385-71 (11/1971).  
Trans. From: Formirovaniye Nanosekundnykh Impul'sov Vysokogo Napryazheniya 1970, pp 1-153  
Availability: AD 733130  
NTIS

The book is devoted to the design and construction of devices producing pulses lasting from one to hundreds of nanoseconds of voltage ranging up to 1000 kV. A survey is given of the existing methods for producing short high-voltage pulses. Various types of circuitry for generators of high-voltage nanosecond pulses are discussed. An analysis is given of transient processes within the framework of equivalent circuits. Engineering calculations are included for the formative elements of various types of generators. Consideration is given to circuits correcting pulse waveforms, and also to circuits used to measure pulse parameters. This book is intended for experimental physicists, specialists in the area of electrical and radio engineering, and for students majoring in engineering. 176 Refs.  
Primary Keywords: Nanosecond Pulse; Pulse Signal; Circuit; Design; Pulse Generators  
Secondary Keywords: Pulse Laser

4076  
(ENERGY STORAGE, CAPACITIVE)  
(Capacitors)  
(HIGH ENERGY DENSITY CAPACITORS FOR VACUUM OPERATION WITH A PULSED PLASMA LOAD)  
W. J. Guman  
Fairchild Industries Inc., Farmingdale, NY 11735  
Final Report, No. NASA-CR-149813, 59p (03/1976).  
Availability: N77-19166/6ST  
NTIS

Results of the effort of designing, fabricating, and testing of a 40 joules/lb (88.2 joules/kg) high voltage energy storage capacitor suitable for operating a pulsed plasma thruster in a vacuum environment for millions of pulses are presented. Using vacuum brazing and heliarc welding techniques followed by vacuum and high pressure helium leak tests, it was possible to produce a hermetically sealed, relatively light weight enclosure for the dielectric system. An energy density of 40 joules/lb was realized with a KF-polyvinylidene fluoride dielectric system. One capacitor was D.C. life tested at 4 kV (107.8 joules/lb) for 2,000 hours before it failed. Another exceeded 2,670 hours without failure at 38.3 joules/lb. Pulse life testing in a vacuum exceeded 300,000 discharges with testing still in progress. The D.C. life test data shows a small decrease in capacitance and an increase in dissipation factor with time. Heat transfer from the load to the capacitor must also be considered besides the self-heat generated by the capacitor.  
Primary Keywords: Capacitors; Energy Storage; Plasma Engines; High Voltages; Vacuum; Accelerated Life Tests; Dielectrics; Failure; Heat Transfer; Plasma Jets  
Secondary Keywords: NTISNASA

4077  
(HIGH VOLTAGE DOUBLE PULSE SYSTEM FOR THE STUDY OF THRESHOLD SWITCHING MATERIALS)  
C. H. Culo  
Ames Lab, IA  
(05/1975).  
Availability: IS 3459  
NTIS

No abstract available.  
Primary Keywords: Semiconductor Switches; Performance Testing; Capacitors; Electric Potential; Electronic Circuits; Mechanics; Pulse Circuits; Pulse Rise Time; Pulses; Transistors  
Secondary Keywords: NTISNASA

4079  
(PULSE GENERATORS; POWER CONDITIONING)  
(Line Type, Pulse Forming Networks)  
HIGH VOLTAGE NANOMSECOND PULSE GENERATORS

C. Zaveles  
Cober Electronics Inc., Stamford, CT 06902  
Eradcom Report No. DELET-TR-77-2641-5 (05/1980).  
Availability: AD A087291  
NTIS

A parallel Blumlein circuit, combined with a spark gap switch, was designed for operation at 24 kV, 5 kA peak. Tests were conducted with a single Blumlein with a 10 ohm load. Because of problems with breakdown in the triggered spark gap, a slightly larger spark gap was substituted. An acceptable pulse was delivered from the pulse forming network after adjustment of the inductive elements in the network. 0 Refs.

Primary Keywords: Pulse Generators; Blumlein; Spark Gap Switch; Avalanche Transistor

4080  
(ENERGY STORAGE, CAPACITIVE)  
(Capacitors)  
HIGH VOLTAGE PULSE CAPACITORS

G.S. Kuchinskii  
FTD, Wright-Patterson AFB, OH  
No. FTD-MC-23-2678-74, 197p (04/1975).  
Availability: AD A017 190/051  
NTIS

High voltage pulse power capacitors are considered in this book. The characteristics of the basic insulation materials are presented. The physical processes arising in pulse capacitors under various operating conditions are considered. A technique is given for calculating the basic dimensions of capacitors, inductance, energy losses, thermal calculations, and evaluation of service life and reliability. The main contemporary types of domestic and foreign pulse capacitors are described.

Primary Keywords: Capacitors; Pulses; High Voltage; Electrical Insulation; Transistors; USSR

Secondary Keywords: NTISDDAF

4081  
HIGH VOLTAGE PULSE GENERATOR

D.L. Phippen  
National Aeronautics and Space Administration, Washington, DC  
Patent No. PAT-APPL-845 365, (09/1970).  
Availability: PATENT-3 530 336  
NTIS

A capacitive discharge circuit is employed to produce a controlled, high voltage, fixed energy spark. A fixed voltage for the spark discharge is provided by a storage capacitor connected in parallel with a Zener diode. Discharge of the capacitor through the primary of an output transformer is controlled by a separately powered control circuit which employs a silicon controlled rectifier (SCR) as a switching device. A Zener diode employed in the control circuit is subject to the storage capacitor voltage and when the desired capacitor voltage is reached, is driven into conduction to fire a second SCR in the control circuit which in turn activates a relay to energize a ready lamp indicating that the circuit is prepared to deliver a fixed energy spark. The charge circuit is manually fired by closing a switch or is automatically fired each time the circuit is prepared to deliver the fixed energy spark by linking the switching mechanism to the relay. After each discharge, the first SCR is automatically commutated by the back EMF of the output transformer and the second SCR is commutated by the AC input to the control circuit.

Primary Keywords: Patents; High Voltage; Pulse; Generator  
Secondary Keywords: PAT-CL-315-241; NTISOPNASA

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4082  
(SWITCHES, CLOSING)  
(Thyristors)  
HIGH VOLTAGE PULSE SUPPLY FOR WIPE SPARY CHAMBER BY MEANS OF THYRATRON  
K.S.T. Matenabe  
Tokyo University, Tanashi (Japan); Inst. for Nuclear Study  
(01/1976).  
Availability: INS-TH-104  
NTIS

The wire spark chamber is being operated conveniently as one of the important track measuring devices in nuclear nucleus interaction experiments with the 1.3 BeV synchrotron in the Institute for Nuclear Study, the University of Tokyo. In order to get the stable operation of the chamber at high efficiency during experimental period, the pulse supply employing a thyristor and filled thyatron was produced for the high voltage circuit. The thyatron used was CX-1150 (EE and V Co., Ltd.), a high performance tube of reduced time jitter, prolonged life, small internal impedance and short transition time. The pulse supply was produced by adding modular units, not paying special care to the power supply and its stabilization, but mainly considering long term stability and easy maintenance. Thus it was divided into a main module, a bias supply and a condenser bank. As a result, the total transition time of the high voltage circuit was 140 ns, while the rise time of output pulses was 60 ns. It has operated stably for over 3 months running time without failure during the continuous operation at 100 Hz repetition rate. 0 Refs. Citation on 08-315679

Primary Keywords: High Voltage; Pulse; Thyristor; Thyatron  
Secondary Keywords: IN JAPAN; ERDA-440330; NTISINIS  
Distribution Restriction: U.S. SALES ONLY

4084  
(ENERGY CONVERSION, ELECTRICAL)  
(Power Supplies)  
HIGH-VOLTAGE SUPPLY SYSTEM FOR ELECTROSTATIC DEFLECTOR  
V.A. Akkuratov, A.A. Glezov, V.V. Kudryashov, M.M. Semenov and M.G. Zhukov  
Joint Inst. for Nuclear Research, Dubna (USSR); Lab. of Nuclear Problems  
(01/1978).  
Availability: JINR-R-9-11344  
NTIS

To increase the efficiency of output of accelerated particles a system of high-voltage supply to the electrostatic deflector of the U-120 M cyclotron was developed. The peculiarity of the system is a possibility of a deep and smooth (90%) regulation of rectified voltage with its stability being preserved. To power the multiplying column assembled using a single-cycle circuit on the 2 Ts 106 G small-dimensional rectifying posts and K15-4 condensers, a transistor converter and a stepup transformer of an original design on a disconnected ferrite core are used, to raise the transformation coefficient and to obtain voltage of a sinusoidal shape the frequency of the converter has been chosen to be equal to the frequency of successive resonance of the transformer scattering induction with the input capacity of the column. The stabilization system consisting of two rings of feedback permitted the combination of deep smooth regulation of rectified voltage and its stabilization with a high accuracy. (Atomizdat citation 10:441637)

Primary Keywords: JINR Cyclotrons; Beam Extraction; Capacitors; Efficiency; Electronic Circuits; Electrostatic Deflectors; Ferrites; Flowcharts; Performance Testing; Power Supplies; Voltage Regulators  
Secondary Keywords: IN RUSSIAN; Foreign Technology; ERDA/430302; NTISINIS; NTISFNUR  
Distribution Restriction: U.S. SALES ONLY.

4086  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
IMPROVED SYSTEM FOR THE MEASUREMENT OF HIGH-VOLTAGE PULSES

W.A. Stephenson  
Sandia Labs., Albuquerque, NM 87115  
(05/1976).  
Availability: SAND-75-0470  
NTIS

A small 71.8 mm x 127 mm (2.83" x 5") capacitive voltage divider is described that is used for measuring waveforms in the 200 kilovolt range with durations of tens of microseconds. The device, immersed in a dielectric fluid, works over the temperature range of 219 to 347 exp 0 K (-65 to +165 exp 0 F). The divider works into an electronic impedance matching line driver which has selectable division ratios of 10,000, 20,000, 30,000, and works into a 50-ohm load. Total deviation in division ratio for the system is in the order of +1.5 percent to -1.05 percent. (ERA citation 01:018878)

Primary Keywords: Capacitors; Electric Measuring Instruments; Neutron Sources; Electric Potential; Electronic Circuits; Pulsed Neutron Techniques; Pulses; Wave Forms  
Secondary Keywords: ERDA/070200; ERDA/440300; NTISERDA

4088  
(PULSE GENERATORS; SWITCHES, CLOSING)  
(Systems; Systems)  
PULSER FOR EMP SIMULATION

W.H. Wright Jr.  
ECOM, Fort Monmouth, NJ 07703  
ECOM Report No. ECOM-4198 (02/1974).  
Availability: ECOM-4198  
NTIS

This development project was undertaken to provide a pulser capable of driving a low-impedance array of antennas with a high-peak-power, short rise-time pulse to simulate the electrical interference effects of an electromagnetic pulse (EMP). The final pulser produced 100 kilovolt (kV), 72 kilampere (kA) output pulse with a 6 nanosecond (ns) voltage rise time and 42 ns current rise time through a single output switch. Additional experiments showed that multiple output switches could reduce the current rise time to 14 ns with a 9 ns jitter. The output switch was a water-cooled air-filled spark gap, and operation in both modes is described. The report also includes design information on a simple and reliable 100 kV DC switch, a low-impedance high power dummy load, and voltage and current measuring devices for viewing fast transients. 10 Refs.  
Primary Keywords: Capacitor Discharge; Strip Line Pulsers; Spark Gap; Water Switch; Dummy Load

4089  
(ENERGY STORAGE, CAPACITIVE)  
(Linear Accelerators)  
REGULATOR FOR HIGH VOLTAGE CAPACITOR BANK  
A.M. Kuznetsov and N.V. Lazarev  
GAT Atomic Energy Institute, Moscow, USSR  
(01/1970).  
Avn Instl Ev. IIEF 761  
NTIS

For abstract, see NSA 25 12, number 28108.  
Primary Keywords: Electron Tubes; Linear Accelerators  
Distribution Restriction: U.S. SALES ONLY

4090  
(RESEARCH STUDIES)  
(Capacitors)  
TANTALUM CAPACITOR BEHAVIOR UNDER FAST TRANSIENT OVERVOLTAGES

J.A. H. and M.D. Castle  
Texas Instruments Center, Houston, TX 77058  
ECOM Report No. ECOM-4198 (12/1974).  
Availability: NTIS 14030  
NTIS

Tantalum capacitors were tested to determine failure time when subjected to short duration, high-voltage surges caused by lightning strikes. Lightning is of concern to NASA because of possible damage to aircraft aircraft circuits. The test was designed to determine the failure time for tantalum capacitor failure and the amount of damage a capacitor could survive, without permanent damage, in a lightning strike. All capacitors tested exhibited good recovery from the test and no failures at any voltage, forward or reverse, in less than 25 microseconds. 0 Refs.

Primary Keywords: Capacitor Breakdown; Circuit Protection; High Voltage; Failure Analysis; Lightning; Leakage  
Secondary Keywords: Electronic Failure

#### 4093 (ENERGY STORAGE, CAPACITIVE; PULSE GENERATORS)

(Marx Generators; Marx)  
THE MOLECULE, A COMPACT, HIGH-DENSITY, HIGH-PRECISION MARX GENERATOR  
D.M. Strickland and W.L. Heatherly  
AFML, Kirtland AFB, NM 87117  
AFML Report No. AFML-TR-73-196 (11/1973).  
Availability: AD 913353  
NTIS

A Marx generator with the highest energy density ever achieved (39 J/pound) is described. The unit, which operates at 2 MV in atmospheric SF<sub>6</sub> at 1 atm, is 2 m long, stores 18 kJ, and weighs 460 pounds. The design incorporates several novel features: the stage capacitors are 100-kV plastic-cased units with a density of 100 joules per pound; grading is achieved by split grading rings, and a conductive elastomer charges and triggers the resistors. Its compactness, light weight, and atmospheric gas insulation ideally suit this Marx design for a variety of applications such as bounded-wave and radiating EMP simulators, plasma devices, laser systems, and electron-beam devices. The modular nature allows the design voltage to be increased or decreased as necessary. The unit has a demonstrated erection jitter of less than 10 nsec over a 7:1 voltage range and consequently can be precisely time-tied to test sequences or to other hardware. 8 Refs.  
Primary Keywords: High Energy Density; Very High Voltage; Grading Rings; Modular Design; EMP Simulation

#### 4100 (SWITCHES, OPENING) (Superconductive)

INVESTIGATIONS ON FAST SWITCHING SUPERCONDUCTIVE/NORMAL CONDUCTIVE CURRENT BREAKERS (CRYOTRONS)

M. Pillsticker  
Institut für Plasmaphysik, Garching, FRG  
Proceedings Of The 6th Symposium On Engineering Problems Of Fusion Research, pp 453-457 (11/1976).  
Operating physical experiments often require switching equipments for the fast commutation of high currents from the current-breaker-branch of a network into an ohmic or capacitive load branch. Considering circuits with superconductive windings breakers working as cryotrons (SC/NC switching) are researched. Requirements for extremely fast current breaking at a minimum trigger energy are defined. Possible are triggering by current pulse and magnetic field pulse. Advantages and disadvantages of the trigger methods are explained. Concepts of breaker units are presented being very small and suitable for single operation as well as in parallel and/or serial arrangement. Breaker units are switched carrying currents of nearly 800 A at the superconductive state before triggering. Current commutation times less than 0.5 microseconds were measured. The maximum switching voltage across a breaker must be less than 5 kV. 4 Refs.

Primary Keywords: Cryotron; Superconductive Switch; Magnetic Field Triggering; Current Pulse Triggering; Zero Resistance; Finite Resistance; Resistive Load  
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#### 4103 (DIAGNOSTICS AND INSTRUMENTATION)

(Voltage)  
MOVEL CAPACITOR-DIVIDER VOLTAGE SENSORS FOR HIGH-VOLTAGE TRANSMISSION SYSTEMS

A. Stelawski (1) and G.C. Waller (2)  
(1) CEGB, Burywood House, Guildford GU2 5BN, UK  
(2) GEC Measurement Ltd, Stafford, UK  
Proceedings Of The IEEE, Vol. 126, No. 11, pp 1186-1195 (11/1979)  
A design is presented for a new capacitive divider and amplifier system for the protection of high voltage power lines. The effect of trapped charge (charge trapped in the divider after the breaker opens) is considered and a solution is proposed. Parasitic inductance effects and problems with discharges caused by pollution are discussed. 10 Refs.

Primary Keywords: Capacitive Voltage Divider; Performance Test; AC Voltage Impulse Voltage; Charge Trapping; DC Offset  
Secondary Keywords: Power Line Protection  
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#### 4105 (ENERGY CONVERSION, ELECTRICAL)

(Charging Circuits)  
PRECISION REGULATED, 20 KW, MODULATOR PFN CHARGING SYSTEM

C.A. Corson  
Westinghouse Electric Corp, Baltimore, MD 21203  
1978 IEEE Thirtieth Modulator Symposium, pp 34-37 (06/1978).  
This paper describes a new, high efficiency, regulated modulator charging system that accurately charges the pulse forming networks (PFNs) in a 14 megawatt modulator to over 5 kV without the use of a conventional high voltage power supply, or dissipative regulator. It is insensitive to load open and short circuits and regulates PFN voltage precisely. The circuit stores a measured amount of energy in a transformer as 1/2 LI<sup>2</sup> sup 2/ and then transfers it to a PFN capacitor as 1/2 CV<sup>2</sup> sup 2/. This technique uses considerably less parts than previous methods and therefore produces impressive size, weight and cost reductions as well as design simplification. It also charges and regulates PFNs more efficiently than previous methods because of using less parts in the main power path and now using a dissipative regulator. 3 Refs.  
Primary Keywords: High Energy; Precise Energy Stored In Transformer; Design Simplification; No Dissipative Regulator  
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#### 4111 (ENERGY CONVERSION, ELECTRICAL)

(Power Supplies)  
CONTROLLED AVALANCHE RECTIFIER CHAINS FOR ACCELERATING VOLTAGE SUPPLIES

M.M. Hanna  
Egyptian Atomic Energy Establishment, Cairo, Egypt  
International Journal Of Electronics, Vol. 34, No. 1, pp 121-126 (11/1973).  
Controlled avalanche rectifier chains are proposed as an alternative to conventional silicon rectifier chains. A Ge voltage sharing capacitors are not needed. Voltage and current distribution is analyzed as are the rectifier current and power ratings. A design example is given. 4 Refs.  
Primary Keywords: Controlled Avalanche Rectifier; Series Connections; Voltage Sharing; No Capacitors  
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#### 4118 PULSE FORMING NETWORKS FOR FAST PUMPING OF HIGH POWER ELECTRON-BEAM-CONTROLLED CO/SUB 2 LASERS

K.B. Riepe  
Los Alamos National Labs, Los Alamos, NM 87545  
No. CONF-751102-1, 10p (01/1975).  
Availability: LA-UR-75-1832  
NTIS

The transverse electric discharge is a widely used technique for pumping CO sub 2 lasers at high pressures for the generation, simply and efficiently, of very high power laser pulses. The development of the electron-beam-controlled discharge has allowed the application of the transverse discharge to large aperture, very high energy systems. LASL is now in the process of assembly and checkout of a CO sub 2 laser which is designed to generate a one nanosecond pulse containing 10 kilojoules, for use in laser fusion experiments. The front end of this laser consists of a set of preamplifiers and a mode locked oscillator with electro-optic single pulse switchout. The final amplifier stage consists of four parallel modules, each one consisting of a two-sided electron gun, and two 35 x 35 x 200 cm gas pumping regions operating at a pressure of 1800 torr with a 3/4 exp 1 / sub 4 / 1 (Marx sub 2 / CO sub 2) laser mix.  
Primary Keywords: Carbon Dioxide Lasers; Pumping; Electric Discharges; Electron Beams; Pulse Generators  
Secondary Keywords: Optical Pumping; NTIS/EDA

#### 4119 (PULSE GENERATORS)

(Trigger)  
SCR TURN-OFF PROBLEM ELIMINATED IN RAPID-FIRE STROBOSCOPE TRIGGER

D. Zinder  
Motorola Semi-conductor Products Inc, Phoenix, AZ 85008  
Electronic Design, Vol. 22, pp 16 (10/1973).  
In the circuit presented a low-voltage rectifier and a high-voltage transistor allow the SCR to turn off when the capacitor charging current is greater than the SCR holding current. Pulse rates of greater than 1 kHz can be achieved. 0 Refs.  
Primary Keywords: Trigger Generator; SCR Switches; Rep-rated; Charging Circuit  
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#### 4123 (PARTICLE BEAMS, ELECTRON)

(Generation)  
EXPERIMENTAL INVESTIGATION OF HIGH-CURRENT RELATIVISTIC ELECTRON FLOW IN DIODES

M. Di Capua, J. Creeden and R. Huff  
Physic International Co, San Leandro, CA 94577  
Journal Of Applied Physics, Vol. 47, No. 5, pp 1887-1896 (05/1976).  
Various aspects of the magnetically self-pinched electron flow patterns in megavolt megampere diodes have been investigated. The onset of pinching has been correlated with a transition from Child-Langmuir to peropotential voltage-current characteristics. The average velocity at which the pinch sweeps towards the axis has been measured and is found to be approximately 0.5c. The invariance of the current under geometrical scaling is demonstrated, and the connection between this invariance and plasma motion is discussed. Measurements of total diode current are compared with existing theories and agreement is found with the peropotential model. 31 Refs.

Primary Keywords: E-beam Generation; Field Emission Diode; Electron Flow; Magnetic Self Pinching; Peropotential Voltage-current Characteristic  
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#### 4129 (INSULATION, MAGNETIC)

(1)  
MAGNETIC INSULATION OF HIGH VOLTAGES IN VACUUM: COMPARISON OF EXPERIMENT WITH SIMULATIONS

K.D. Bergeron (1), J.W. Poukey (1), M.S. Di Capua (2) and D.G. Pellinen (2)  
(1) Sandia Labs, Albuquerque, NM 87115  
(2) Physic International Co, San Leandro, CA 94577  
Sandia Report No. SAND-78-1145C (09/1978).  
Availability: SAND-78-1145C  
NTIS

Experiments on long magnetically insulated vacuum transmission lines at the 700 kV/cm level have been analyzed by computer simulations. The particle-in-cell code used is 2-D, time-dependent and, like the experiments, coaxial cylindrical. Comparison could be made with current monitors at three intermediate longitudinal positions at both the outer electrode (for total current) and the inner electrode (for boundary current). The overall agreement was quite good, though the measured boundary current was consistently about 22% lower than the simulation values. In addition, a detailed comparison of the radial variation of several time-averaged quantities from the simulation was made with the predictions of the peropotential theory. It was found that the electric potential was very similar in the two cases, but the charge and current densities were not. 12 Refs.  
Primary Keywords: Long Transmission Line; Experiment; Theory; Current Measurement; Particle-in-cell Computer Code; Good Agreement

#### 4136 (PARTICLE BEAMS, ELECTRON)

(Transport)  
TRANSPORT OF A RELATIVISTIC ELECTRON BEAM TO A FUSION TARGET

I.I. Rudakov  
V.V. Kurchatov Institute of Atomic Energy, Moscow, USSR  
Soviet Journal Of Plasma Physics, Vol. 4, No. 1, pp 40-43 (01/1978).  
Trans. From: Fizika Plazmy, Vol. 4, pp 72-77, (Jan-Feb 1978).  
9 Refs.

Primary Keywords: Vacuum Line; Magnetic Insulation; 5 Meter Distance; 10e14 Watt Beam; Turbulent Heating In High Current Diode  
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4143  
(INSULATION, MATERIAL)  
(Systems)  
A GAS-SUPPLY LINE WHICH PERMITS A HIGH VOLTAGE TO BE MAINTAINED ACROSS ITS ENDS  
G.C. King, M. Trone and R.C. Bradford  
University of Manchester, Manchester, UK  
Journal Of Physics E: Scientific Instruments, Vol. 9, pp 1049-1050 (12/1976).  
A simple gas-supply line is described which allows a high voltage to be maintained across its ends at gas pressures in the gas line at which electrical breakdown would normally occur. It consists of a series of insulated electrically conducting tubes across which resistors are connected in a similar manner to the dynode resistor chain of a photomultiplier. In the present application a voltage of 2.5 kV is maintained across the ends of the gas line, but this may readily be increased. 1 Refs.  
Primary Keywords: Gas-supply Line; Enhanced Insulation Properties; Increased Breakdown Voltage; Grading Resistor  
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4147  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
OPERATION OF SLIDING-SPARK ARRAYS FOR LASER PRE-IONIZATION  
B. Morris and A.L.S. Smith  
University of St. Andrews, St. Andrews, Fife KY16 9SS, UK  
Journal Of Physics E: Scientific Instruments, Vol. 10, No. 5, pp 551-554 (05/1977).  
The electrical conditions necessary for reliable operation of sliding-spark arrays have been determined. The emission from an array can be considerably enhanced by critically damping the spark discharge circuit. When used to pre-ionize a CO/sub 2/ laser there must be a delay between the array and main discharge pulses, but this delay may be as small as 100 ns and less than the array discharge pulse width. 10 Refs.  
Primary Keywords: "Sliding Spark"; Series Breakdown; Multiple Gaps; Minimum Charging Voltage  
Secondary Keywords: Gas Laser Pumping  
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4149  
(REVIEWS AND CONFERENCES)  
(Conferences)  
IEEE 1973 MODULATOR SYMPOSIUM  
(09/1973).  
This conference record includes 58 papers relating to the generation of medium to high power pulses with very carefully controlled parameters. Papers on switching, pulse generation, and energy storage are included. Thirty seven papers are referenced separately.  
Primary Keywords: Modulators; Hard-tube Pulse Generators; Thyatrons; Thyristors  
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4157  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
FOUR-METER SPARKS IN AIR  
M.A. Uman (1), R.E. Orville (1), A.M. Slatten (1) and E.P. Krider (2)  
(1) Westinghouse Research and Development Center, Pittsburgh PA  
(2) University of Arizona, Tucson, AZ 85721  
Journal Of Applied Physics, Vol. 39, No. 11, pp 5162-5168 (10/1968).  
Sparks of 4-m length in atmospheric air were studied, using high-speed image-converter photography, current and voltage measurements, absolute measurements of radiated light intensity, and high-speed image-converter spectroscopy. Correlated results of the various measurements are presented. The energy balance of the spark is discussed. 12 Refs.  
Primary Keywords: Long Spark; Rod-plane Gap; Both Polarities; Photographic Observation; Voltage Measurement; Current Measurement; Comparison With Lightning  
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4186  
(INSULATION, MATERIAL)  
(Liquid)  
THE ASSIGNMENT OF APPROPRIATE DIELECTRIC STRESSES IN LIQUIDS  
G.K.M. Simcox  
Meggapulse, Inc., Bedford, MA  
5th International Conference On Conduction And Breakdown In Dielectric Liquids pp. 179-182 (07/1975).  
Liquid dielectrics are in common use in the electrical equipment industry and are often used, in perhaps greater variety, for the insulating media of high voltage pulse generators. The requirements for these two areas are distinct and different. For the former, long term reliability and economic upkeep are mandatory and, for the latter, the emphasis is on peak performance at low duty cycle. On the one hand the dielectric is stressed continuously by AC-DC voltages and, on the other, the stresses are of microsecond duration or less, with seconds between stresses. This alone would indicate the use of different stress levels but, for liquids, there are added complications due to contaminants. These seriously reduce the electrical performance of liquids for prolonged AC-DC stress applications but have little influence upon the short, microsecond, pulse performance. Because of these differing requirements and characteristics there are interesting contrasts of style and content in the publications of research workers in these respective fields. 7 Refs.  
Primary Keywords: Liquid Dielectric; Dielectric Stress; AC Fields; DC Fields; Impulse Fields; Streamer Velocity  
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4187  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Electrodes; Vacuum Gaps; Materials)  
EROSION CRATERS AND ARC CATHODE SPOTS IN VACUUM  
B. Juttner  
German Academy Of Sciences, East Berlin, DDR  
Beitr. Plasma Physics, Vol. 19, No. 1, pp. 25-48 (01/1979).  
The author describes experiments which examine erosion craters on clean, smooth cathodes. The discharges have durations on the order of nanoseconds with a current ranging from 10 to 200 amps. It is proposed that the craters are the result of discharge pressure on molten metal in a spot, and that the spots move in a random manner one crater radius at a time because of the microspikes that are formed at the edge of the crater. The dependence of crater size, erosion rate and velocity of spot displacement on current is also measured. 36 Refs.  
Primary Keywords: Erosion Crater; Discharge Pressure; Molten Metal; Spot Movement  
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4188  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Electrodes; Vacuum Gaps; Materials)  
EROSION STRUCTURES ON CATHODES ARCED IN VACUUM  
J.E. Daelder  
Eindhoven University of Technology, Eindhoven, Netherlands  
J. Phys. D: Appl. Phys., Vol. 12, pp 1769-1778 (01/1979).  
The author presents a discussion of the erosion craters that form on the cathode during a discharge in a vacuum using total currents up to a few hundred amps. The cathode materials studied are cadmium, copper, molybdenum, and tungsten. Cathode spots can move either randomly, or along a path determined by the magnetic field, but the spot movement can also be greatly affected by surface contamination. A three-dimensional analysis of a crater is presented. Crater formation is analyzed in terms of ion flow incident on the cathode surface. 14 Refs.  
Primary Keywords: Cathode Erosion Structure; Vacuum Arc; Low Current; High Purity Electrode; Cathode Spot Movement  
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4191  
(SWITCHES, CLOSING)  
(Surface Discharge; Electrical)  
A TEST OF A VACUUM/DIELECTRIC SURFACE FLASHOVER SWITCH  
I.D. Smith  
Lawrence Livermore Lab, Livermore, CA 94550  
Report No. UCID-18555 (02/1980).  
Availability: UCID-18555  
NTIS  
A vacuum surface flashover switch is being considered for >10 kHz operation in a 250 kV, 10 ohm, 40 ns coaxial water Blumlein. Various possible switch designs are compared, and two promising ones selected for tests in the switch test facility at LL. The initial test configurations are described. 9 Refs.  
Primary Keywords: Vacuum Surface Flashover Switch; High Rep-rate; Low Jitter

4192  
(SWITCHES, CLOSING)  
(Gas Gaps; Crossed-field)  
CROSSED-FIELD CLOSING SWITCH DEVELOPMENT  
R.J. Harvey  
Hughes Research Labs, Malibu, CA 90265  
ECOM Report No. ECOM-76-1313-F (01/1977).  
Availability: AD A035609  
NTIS  
A triode version of the crossed-field closing switch has been successfully tested at average powers of up to 800 kW for burst durations of 30 sec. Unlike most conventional spark gaps, the arc is initiated from a crossed-field glow discharge and occurs at random locations on a shot-to-shot basis. This uniformly disperses the heat loading and erosion over a relatively large electrode surface area which may then be cooled. 10 Refs.  
Primary Keywords: Closing Switch; Arc Discharge; Crossed Field

4196  
(INSULATION, VACUUM)  
(Reviews)  
HIGH VOLTAGE BREAKDOWN STUDY: HANDBOOK OF VACUUM INSULATION  
M.J. Mulcahy and P.C. Bolin  
Ion Physics Corporation, Wilmington, MA 01803  
ECOM Report No. ECOM-00394-20 (02/1971).  
Availability: AD 723107  
NTIS  
The 'Handbook on Vacuum Insulation' discusses the factors influencing breakdown in high voltage vacuum devices. The data on the factors, interactions and theories on vacuum breakdown are interpreted and presented in a manner so as to be useful in the design of microwave and modulator tubes that must operate at voltages greater than 100 kV. It is produced as part of a 5-year program, which was carried out at Ion Physics Corporation, to investigate, under controlled conditions and using factorial design and analytical techniques, vacuum breakdown up to 300 kV for conditions pertinent to high power vacuum tubes. The handbook is intended both as an introduction to, and realistic appraisal of, the use of vacuum as the insulating medium for high voltage and high power tubes. As such, it contains general discussion and recommendations pertaining to factors, levels, combinations and interactions of same, preparation, conditioning and operating procedures, etc. The handbook first describes briefly the experimental program. This is followed by an introduction to the basic phenomena of vacuum insulation and a short review of the major theories of vacuum breakdown. The factors of practical import which influence insulation of metal electrodes in vacuum are then discussed in some detail. A final section briefly discusses the role of solid dielectrics in vacuum insulation. 8 Refs.  
Primary Keywords: Electrical Breakdown In Vacuum; Prebreakdown Phenomena In Vacuum; Criteria For Vacuum Breakdown; Optical And X-Radiation; Electric Field Enhancement And Etching; Conditioning Procedures; Electrode Materials And Surface Properties  
Secondary Keywords: Factors Influencing Vacuum Breakdown; Partial Pressure And Gap Current; Breakdown Voltage And Voltage Collapse

4200  
(SWITCHES, CLOSING)  
(Gas Gaps; Electrical)  
HIGH POWER SWITCH DEVELOPMENT  
E. Kunhardt and M. Kristiansen  
Texas Tech University, Lubbock, TX 79409  
AFOSR Report No. AFOSR-TR-80-0171 (11/1979).  
Availability: AD A081870  
NTIS  
Studies on the triggering of a high-voltage, gas-insulated spark gap by an electron beam have been conducted. Measurements of the gap voltage, current, and jitter have been made for a wide range of gap conditions and electron-beam cross-sectional areas. The character of the breakdown, for each condition, has been inferred using photographic techniques. Current rise times of approximately 2 ns with subnanosecond jitter have been obtained for 3 cm gaps with gap voltages as low as 50% of the self-breakdown voltage. The observational time lag, i.e. the interval of time between the application of a voltage pulse to the electron gun and the beginning of the current rise in the gap circuit, was 50 ns. The gases used in this series of experiments were N/sub 2/ and Ar, and mixture of N/sub 2/ and SF/sub 6/ at pressures of 1-3 atm. Open shutter photographs show that the discharge is broad in cross-section. A number of papers reporting the results obtained in this program have been given at international conferences and two master theses were completed. 5 Paps.  
Primary Keywords: Electron Beam Triggered Switch; Electron Gun; Spark Gap Switch Model

4201  
(SWITCHES, CLOSING; SWITCHES, OPENING)  
(Gas Gaps, E-beam; Gas Gaps, E-beam)  
HIGH VOLTAGE SWITCH USING EXTERNALLY IONIZED PLASMAS

J.M. Dziamianski and L.E. Kline  
Westinghouse Electric Corp., Baltimore, MD 21203  
AFAL Report No. AFAL-TR-80-2041 (04/1980).  
Availability: AD A086761  
NTIS

A physical model was developed and the performance parameters were studied for high-voltage high-current on/off switches which use the low energy secondary electrons in an electron beam sustained discharge as the conducting medium. The model equations are presented and described along with the underlying physical assumptions. Electron transport data and static breakdown voltages were calculated for  $N_2$  sub 2%, Ar, a  $N_2$  sub 2%: Ar=1:9 mixture and  $CH_4$  sub 4% by numerically solving the Boltzman equation to find the energy distribution. Study of steady state performance for  $N_2$  sub 2%, Ar,  $N_2$  sub 2%: Ar=1:9 and  $CH_4$  sub 4% indicated that the  $N_2$  sub 2%: Ar=1:9 and  $CH_4$  sub 4% were both good candidate gases; hence transient switch performance were studied for these two gases. The performance of the e-beam plasma switches were mapped in a regime where the power delivered to the load is much greater than the e-beam power. Study of e-beam sources pointed to the thin-film field emission cathode as offering a means of controlling e-beam plasma switches with very high control power gain. A switch geometry was suggested using such an e-beam source. 52 Refs.

Primary Keywords: E-Beam; Plasma; High Voltage; High Current;  
Thin-Film Field Emission; Electron Transport Data  
Secondary Keywords: Switch

4202  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
INVESTIGATION OF THE RESISTIVE PHASE IN HIGH POWER GAS SWITCHING

R.C. O'Rourke  
Science Applications, La Jolla, CA 92037  
LL Report No. UCRL-13776 (01/1977).  
Availability: UCRL-13776  
NTIS

The authors derive an empirical formula for the time dependent resistance of a gas spark gap using experimental values of the voltage fall time across a gap. A model is chosen and assumptions are made to reduce the problem to a tractable form. The values obtained experimentally for the fall times of the voltage are inserted to give a formula for the time dependent resistance of the gap. The authors then proceed to consider the problems associated with designing a re-rapid system using spark gaps. 12 Refs.

Primary Keywords: Gas Gaps; Resistive Phase; Empirical Formula; Spark Gap Model

4204  
(SWITCHES, CLOSING)  
(Gas Gaps, Optical)  
LASER CONTROL OF SPARK GAPS

E.A. Lemberg  
Joint Proliferations Research Service, Arlington, VA  
JPRS Report No. JPRS-59677 (08/1973).  
Availability: JPRS-59677  
NTIS

The report contains discussions on the use of pulsed ultraviolet waveband gas lasers to switch spark gaps and the time characteristics of spark gaps activated by laser pulses. 4 Refs.

Primary Keywords: Spark Gap Triggering; Nitrogen Laser; Delay Measurement; Jitter Measurement; Synchronization Of Gaps

4205  
(PARTICLE BEAMS, ION)  
(Generation)  
GENERATION OF INTENSE ION BEAMS IN PULSED DIODES

R.M. Sudan and R.V. Lovelace  
Cornell University, Ithaca, NY 14850  
Physical Review Letters, Vol. 31, No. 19, pp 1174-1177 (11/1973).

The generation of high-current (approximately 1E5 A) pulsed ion beams with ion energy in the range 0.5-10 MeV appears to be possible by modifications of present electron-beam technology. 8 Refs.

Primary Keywords: Ion Beam Generation; Ion Emission; Electron Current Suppression; Transverse Magnetic Field

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4208  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
OWL II DIODE STUDY

K. Childers and C. Stallings  
Physic International Co., San Leandro, CA 94577  
DNA Report No. DNA 4432F (12/1977).  
Availability: AD A052578  
NTIS

An experimental program performed on the OWL II pulsed electron beam accelerator with mean electron energy of 950 keV and electron beam energy of 80 kJ has been accomplished. The reliability of the accelerator was shown to be greater than 90 percent at the 90 percent confidence level. The repeatability of the accelerator can be characterized by  $\pm 4$  percent MSD of beam energy in the diode,  $\pm 2$  percent MSD of mean electron energy in the diode, and  $\pm 8$  percent MSD of average fluence at target location. Electron beams with areas in excess of 400 sq. cm., depths of penetration in excess of 0.6 gm/sq. cm. and peak doses ranging from 25 to 100 cal/gm were characterized for future thermal structural response testing. 0 Refs.

Primary Keywords: Electron Beams; Thermal Structural Response Testing

4209  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Gas, Electrical; Gas Gaps, Electrical)  
PARAMETERS AFFECTING FIRING TIME OF SIMULTANEOUSLY TRIGGERED TRIGATRON SPARK GAP SWITCHES

M.D. Williams  
Langley Research Center, Hampton, VA  
NASA Report No. NASA TN D-5077 (03/1969).  
Availability: N69-20888  
NTIS

This report describes a technique and apparatus for spark gap research and presents the results of an investigation performed with that apparatus. The investigation was conducted primarily to determine how the variation of each of several spark gap parameters affects the firing-time differences (switch jitter) of simultaneously triggered trigatron spark gap switches. These parameters were switch voltage (15 to 20 kV), peak trigger voltage (14 to 20 kV), and the curvature of the edge of the trigger electrode hole. The firing times were measured using the light emitted from the switches. 5 Refs.

Primary Keywords: Trigatron Switch; Gap Voltage Variation; Trigger Voltage Variation; Curvature Of Trigger Hole; Experiment; Theory; High Switch Voltage

4210  
(ENERGY STORAGE, INDUCTIVE)  
(Systems)  
PULSE POWER SYSTEMS EMPLOYING MAGNETIC ENERGY STORAGE

T.F. Trost  
Texas Tech University, Lubbock, TX 79409  
NSAC Final Report On Contract No. N60921-76-C-0092 (05/1977).  
Availability: AD A039 897  
NTIS

Several basic aspects of pulsed power systems supplying repetitive pulses and using inductive energy storage are investigated. These include the method of inductor charging; the efficiency of discharging with a regenerative switching circuit; the limitations of thermally driven resistors as opening switches; the design of pulse forming networks for time-varying resistive loads and the relative merits of voltage-fed versus current-fed networks, and some limitations on inductors. 22 Refs.

Primary Keywords: Inductive Energy Storage; Pulsed Power Systems

4212  
(SWITCHES, CLOSING; SWITCHES, CLOSING; BREAKDOWN STUDIES)  
(Gas Gaps, Optical; Systems; Gas, Optical)  
SYMPATHETIC BREAKDOWN IN AIR

J.P. Brainerd and L.A. Andrews  
Sandia Labs, Albuquerque, NM 87115  
Sandia Report No. SAND77-1203 (08/1977).  
Availability: SAND77-1203  
NTIS

The breakdown of a spark gap by UV radiation from another spark gap is presented in this report. In this experiment, two air gaps were placed various distances apart. The behavior of the gaps under observation is studied with relation to a gap that is triggered by other means. The mechanism of breakdown in the gap under observation is found to be ultraviolet radiation from the control gap. 3 Refs.

Primary Keywords: Sympathetic Breakdown; UV Radiation; Medium Voltage  
Secondary Keywords: Lightning Arrestor

4214  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
THE STATISTICAL DISTRIBUTION OF VALUES OF BREAKDOWN VOLTAGE FOR AN AIR GAP

W.P. Baker  
Electricity Council Research Centre, Capenhurst, UK  
Electricity Council Research Report No. ECRC/M-1283 (09/1979).  
Availability: ECRC M1283  
NTIS

An analysis of 30,000 measurements of breakdown voltage on a spark gap removed from a surge diverter shows there to be a linear relation between normal probability and the logarithm of the excess of the applied voltage over a critical voltage. This linearity extended over more than six standard deviations. A statistical model is derived which agrees well with the experimental findings and which is investigated further to show that the physical parameter of the breakdown process in air which controls the scatter of test results is the rate of change of the first Townsend coefficient with field. 0 Refs.

Primary Keywords: Spark Gaps; Dielectric Breakdown; Foreign Technology; Percent Overvoltage; First Townsend Coefficient

4216  
(INSULATION, MATERIAL)  
(Gas)  
BEHAVIOR OF AIR INSULATING GAPS OF DC SYSTEMS UNDER IMPULSE, DC AND COMPOSITE VOLTAGES

C. Manenahis and G. Harbec  
Hydro-Quebec Institute of Research, Varannes, Quebec, Canada  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-98, No. 6, pp 2065-2075 (12/1979).

This paper deals with the behavior of air insulating gaps of direct current (DC) transmission systems in the voltage range of  $\pm 600$  kV to  $\pm 1200$  kV. The gaps studied were simulating either a bipolar DC tower or a bipolar rigid bus system. The influence of the terminations of the two ends of the insulator supporting the bus was investigated by using a single bus supported at one end. The breakdown voltage of the gaps was determined for a pure impulse, pure DC voltage or composite voltage formed by a DC on which an impulse was superimposed. The proximity effect of one pole on the pole-to-ground breakdown voltage of the other was also investigated. 7 Refs.

Primary Keywords: Air Insulating Gaps;  $\pm 600$  kV To  $\pm 1200$  kV Voltage Range; Impulse, DC, And Composite Test Voltages; Bipolar Buses; Rod-plane Breakdown Voltage; Forming Electrodes

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4236  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
MODEL FOR A LOW PRESSURE SPARK GAP  
E.P. Lee  
Lawrence Livermore Lab, Livermore, CA 94550  
LIL Report No. UCID 18059 (02/1979).  
Availability: UCID 18059  
NTIS  
The space and time-dependent generation of plasma in a low pressure spark gap is modeled with a two-dimensional Boltzmann equation. 0 Refs.  
Primary Keywords: Low Pressure Spark Gaps; 2-D Boltzmann Equation; Numerical Calculation; Approximate Solution

4237  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
HIGH POWER SPARK GAP SWITCH PROGRAM  
J. Heckl (1), W. Clark (2) and J. Driscoll (3)  
(1) Naval Surface Weapons Center  
(2) Maxwell Labs Inc. San Diego, CA 92123  
(3) University of Michigan, Ann Arbor, MI  
1976 IEEE Pulsed Power Conference Proceedings, Paper IB-1 (11/1976).  
We will highlight a program presently underway into the investigation and final development of a spark gap switch capable of operating at repetition rates of 50 to 250 pulses/sec at voltages of several hundred kilovolts and 3 megawatts average power. Results of an Aero Propulsion Laboratory program on High Power Spark Gap Switch Development will be given; it will be shown how these results have led to the present study. The present investigation, a coordinated effort between the Gas Dynamics Laboratories of The University of Michigan, Naval Surface Weapons Center and Maxwell Laboratories, Inc., will be described. Theoretical investigations into the nature of dynamic nonstationary arcs under transverse gas flow conditions between electrodes will be discussed. Future plans for experimental studies of arc properties include time resolved temperature measurements using a unique optical scanning system at The University of Michigan. An optimized high power spark gap switch will be designed and fabricated by Maxwell Laboratories and tested at their switch test facility. 8 Refs.  
Primary Keywords: Spark Gap; High Rep-rate; Nonstationary Arcs  
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4248  
(REVIEWS AND CONFERENCES; BREAKDOWN STUDIES)  
(Reviews; Reviews)  
BASIC PROCESSES OF GASEOUS ELECTRONICS  
L.B. Loeb  
University of California, Berkeley CA  
Publisher: Univ. Of California Press, Berkeley And Los Angeles, California (02/1955).  
The thrust of this book is consideration of the basic phenomena associated with gaseous electronics. Ionization, ionization, and recombination, are all considered as are energy distributions of particles and electron attachment. Each chapter includes a short historical background of the discoveries leading to the state-of-the-art. The relevant experiments used to collect the pertinent data are presented along with the data and the theory behind it. 464 Refs.  
Primary Keywords: Gaseous Electronics; Ion Mobility; Electron Mobility; Energy Distribution; Negative Ion; Recombination; Ionization  
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4263  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
HIGH-CURRENT PULSED ELECTRON ACCELERATOR WITH AN ANNULAR BEAM  
M.I. Avramenko, V.A. Glukhikh, O.A. Gusev, E.G. Komar, G.L. Komarov, V.S. Kuznetsov, A.S. Perlin and M.P. Svin'in  
D.V. Efremov Institute, Leningrad, USSR  
Soviet Physics-Technical Physics, Vol. 19, No. 3, pp 368-370 (09/1974).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 44, 591-595 (March 1974).  
Certain questions related to the design and construction of a high-current pulsed accelerator with a pulse length of 1E-4 sec, a beam current of 2E4 A, and an electron energy of 1 MeV are discussed. The pulsed accelerating voltage is produced by an electrical solenoid in which energy from an auxiliary power supply is stored with a high-speed current switch. It is shown that an annular thermionic cathode should be used to produce a beam having the specified parameters. The focusing and maintenance of the annular structure of the beam are achieved by means of the inhomogeneous magnetic field of the solenoid. 5 Refs.  
Primary Keywords: Electron Accelerator; Annular Beam; 100 Microsecond Pulse; 20 kA Beam Current; Thermionic Cathode  
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4276  
(SWITCHES, CLOSING)  
(Surface Discharge, Electrical)  
LOW-INDUCTANCE MEGAAMPERE-CURRENT COMMUTATOR BASED ON SLIDING DISCHARGE  
A.V. Grigor'ev, P.M. Dushuk, S.M. Markov, V.L. Shutov and M.D. Yuryshchev  
Leningrad Polytechnical Institute, Leningrad, USSR  
Instruments And Experimental Techniques, Vol. 19, No. 4, pp 1104-1106 (08/1976).  
Trans. From: Pribury i Tekhnika Eksperimenta 4, 151-153 (July-August 1976).  
An air spark gap is described in which current commutation is realized by a multichannel discharge along the surface of the solid dielectric, which is created during the development of a sliding discharge. The spark gap repeatedly commutated currents of 500 kA. The self-inductance of the spark gap amounted to  $L_{sub} \approx 5$  nH under these conditions, while its resistance was  $r_{sub} \approx 7E-3$  ohm.  
Primary Keywords: Surface Discharge Switch; Multichannel Discharge; Sliding Discharge; 500 kA Current; 5 nH Gap Inductance  
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4291  
(SWITCHES, CLOSING)  
(Vacuum Gaps, Optical)  
LASER-TRIGGERED SWITCH STUDY (PROJECT LASWITCH)  
R.J. Clark  
Cornell Aeronautical Lab Inc, Buffalo, NY 14221  
RADC Report No. RADC-TR-68-355 (12/1968).  
Availability: AD 846056  
NTIS

Interaction between the emission from a pulsed laser and a metallic surface in vacuum has been investigated as a means of initiating a plasma discharge between isolated electrodes. Experimental studies of the triggering and arc development processes were carried out at applied potentials of several kilovolts and discharge currents up to the kiloampere level. Electrode and optical energy density effects were examined and compared in discharge service. A prototype switch designed for operation at 20 kilovolts, 10 megawatts was tested with a pulsed gas laser trigger and shows promise of reasonable life. Switching experiments were also performed at potentials in excess of 200 kilovolts. A parallel study of magnetic arc quenching phenomena led to the development of an electrically triggered low impedance switch that could pulse modulate the output of a hard energy storage system, supplying peak powers of several hundred kilowatts. 0 Refs.  
Primary Keywords: Laser Triggering; Arc Development; Pulsed Gas Laser; Electrode Effects

4298  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Current)  
FIBRE-OPTICAL CURRENT MEASUREMENT  
A.J. Rogers  
Central Electricity Generating Board, London, UK  
No. TDB-280, 4p (03/1977).  
Availability: N78-28428/85T  
NTIS

A simple, cheap, and reliable arrangement for fiber optic current measurement, consisting of fiber, a light emitting diode, two polarizers, a photodetector, and an output signal amplifier, is described. Successful laboratory tests were carried out. The use of monomode fiber looks more promising than that of multimode fibers.  
Primary Keywords: Electric Current; Fiber Optics; Measuring Instruments; Fibers; Equipment Specifications; High Voltages; Polarizers  
Secondary Keywords: Great Britain; NTISNAE

4302  
(SWITCHES, CLOSING)  
(Vacuum Gaps, Electrical)  
LOW-VOLTAGE AND HIGH-CURRENT DELAY CHARACTERISTICS OF A SIMPLE TRIGGERED VACUUM GAP  
S. Kamakshiah and R.S.M. Rau  
Indian Institute of Science, Bangalore, India  
Journal Of Physics D: Applied Physics, Vol. 10, No. 7, pp 1017-1022 (06/1977).

Low-voltage and high-current switching delay characteristics of a simple triggered vacuum gap (TVG) are described using lead zirconate titanate as the dielectric material in the auxiliary gap. This TVG has superior performance at high currents (up to 14 kA was studied) with regard to easy, reliable firing and extended life as compared to the one using either Supramica (Mycel Corporation of America) or silicon carbide. The latter materials were used in our earlier work which was confined to low currents up to 2.5 kA. The total delay consists of three intervals: to break down the auxiliary gap, to propagate the trigger plasma, and to break down the main gap. The data on the influence of the various parameters like the trigger voltage, current, energy and the main circuit energy are given. It has been found that the delay due to the first two intervals is small compared to the third. 10 Refs.  
Primary Keywords: Low Voltage; 14 kA Current; Trigger Gap; Variable Trigger Voltage; Variable Current; Variable Energy; Delay Measurement  
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4305  
(PULSE GENERATORS)  
(Trigger)  
PICOSECOND TRIGGER SYSTEM USEFUL IN MODE-LOCKED LASER PULSE MEASUREMENTS  
B. Cunin, J.A. Mehe, B. Sipp and J. Thebaud  
CEA Centre d'Etudes Nucleaires, Sarclay, France 92260  
Availability: CRN-CNPA-76-21  
NTIS

A highly sensitive tunnel diode trigger useful in temporal intensity build-up measurements of mode-locked lasers has been developed; the device reduces notably the time walk due to the lack of repeatability in intensity of the laser output. The performance of the trigger have been established by means of a GHz wideband 0.1V/cm sensitive real-time oscilloscope and of an image converter camera having a picosecond resolution: the experimental results show that a variation of the amplitude of the laser pulse train of a factor 5 leads to a time jitter of less than 30 ps. (Atomindex citation 08:301921)  
Primary Keywords: Lasers; Tunnel Diodes; Mode Locking; Performance; Pulses; Timing Properties; Trigger Circuits; Ultrahigh-speed Photography  
Secondary Keywords: EPDA/420300; France; Mode Locked Lasers; NTISIMIS  
Distribution Restriction: U.S. Sales Only.

4336  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
HIGH-VOLTAGE PROBE SYSTEM WITH SUBNANOSECOND RISE TIME  
W.J. Sarjeant and A.J. Alcock  
National Research Council, Ottawa, Ontario, Canada  
The Review Of Scientific Instruments, Vol. 47, No. 10, pp 1283-1287 (10/1976).

A high-voltage probe measuring system with an overall rise time of less than 50 psec and a peak voltage capability of 20 kV has been developed. Probe perturbations at the 50 ohm impedance level are minimized by maintaining a moderately high input impedance in conjunction with the absorption of internal reflection waves by means of a lossy distributed transmission line. System long term stability and constructional reproducibility have been investigated. 17 Refs.  
Primary Keywords: Voltage Attenuator; 20 kV Voltage Capability; 50 psec Rise Time; 3000 Ohm Input Impedance; Ferrite Loaded Transmission Line  
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4342  
(BREAKDOWN STUDIES)  
(Lightning)  
LABORATORY SIMULATION OF THE STEPPED LEADER IN LIGHTNING  
M.M. Kekez and P. Savic  
National Research Council, Ottawa, Ontario, Canada  
Canadian Journal Of Physics, Vol. 54, pp 2216-2224 (07/1976).  
The stepped leader in lightning is shown to be a relaxation oscillation phenomenon. The stepped leader was simulated by adding a parallel RC combination to the external circuit of a discharge gap. Experiments were also done in a well-preionized gas where there was no displacement current. 15 Refs.  
Primary Keywords: Stepped Leader; Nonlinear Glow; Relaxation Oscillation; Simulation  
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4347  
(SWITCHES, CLOSING; BREAKDOWN STUDIES)  
(Liquid Gaps, Optical; Liquid, Electrical)  
ON THE USE OF PERFLUOROPOLYETHER FLUIDS IN HV SPARK-GAPS  
A. Luchesi and L. Provenzano  
Universita di Lecce, Lecce, Italy  
Journal Of Physics D: Applied Physics, Vol. 10, No. 3, pp 339-341 (02/1977).  
Tests were performed to examine the dielectric properties of perfluoropolyether fluids (Fomblin Y) and their transparency to ultraviolet radiation. The purpose was to evaluate the advantage of their use in high-power spark-gaps, triggered by pulsed Nd:sub 2 / lasers (3371 angstroms). Our results show that the perfluoropolyether fluids exhibit many advantages over the commonly used transformer oil. 3 Refs.  
Primary Keywords: Perfluoropolyether Fluid; Nitrogen Laser Triggering; Self Healing; Fluid Aging; Resistivity Measurement  
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4348  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES)  
(Vacuum, Electrical; Vacuum, Magnetic Field)  
PERTURBATION OF THE STATIC VOLTAGE BREAKDOWN MECHANISM IN VACUUM BY A WEAK MAGNETIC FIELD  
A. Watson  
University of Western Ontario, London, Ontario, Canada  
Canadian Journal Of Physics, Vol. 54, pp 2403-2417 (01/1976).  
An analysis is presented of the effect of a weak magnetic field on the breakdown mechanism concentrating on the magneto-transport phenomena in a semiconducting field emitter. The geometry of a cathode protrusion is also considered. A new model of the breakdown mechanism is developed by altering the Fowler-Nordheim equation. A close agreement is found between predictions by this model and experimental results. 11 Refs.  
Primary Keywords: Magnetic Field; Perturbation Of Breakdown Voltage; Field Emission; Poor Vacuum; Low Magnetic Field; Transverse Field; Copper Electrode  
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4358  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
A QUICK RESPONSE HIGH VOLTAGE DIVIDER  
Y. Kubota, M. Kobayashi and A. Miyahara  
Mogaya University, Mogaya, Japan  
Japanese Journal Of Applied Physics, Vol. 15, No. 10, pp 2037-2038 (10/1976).  
The authors describe a resistive voltage divider for use in a noisy pulsed power environment. The divider is constructed of a plexiglass tube filled with a copper sulphate solution. The divider employs a copper sulphate guard resistor for noise reduction. 2 Refs.  
Primary Keywords: Resistive Voltage Dividers; Guard Resistor; Copper Sulphate Solution; 2 MV Voltage Range  
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4369  
(BREAKDOWN STUDIES; SWITCHES, OPENING)  
(Gas, Electrical; Gas Gaps, Materials)  
HIGH VOLTAGE RESEARCH (BREAKDOWN STRENGTHS OF GASEOUS AND LIQUID INSULATORS) AND ENVIRONMENTAL EFFECTS OF DIELECTRIC GASES  
L.G. Christophorou, D.R. Jones, R.Y. Pai, R.A. Mathis, I. Sauer, L. Frees, M.O. Pace, D.W. Bouldin and C.C. Chen  
Oak Ridge National Lab, Oak Ridge, TN 37830  
ORNL Report No. ORNL/TM-7173 (01/1980).  
Availability: ORNL/TM-7173  
NTIS  
A number of gas mixtures are suggested for industrial-scale testing. Electron attachment rates were measured and unfolded to give attachment cross section functions for several gases each in N/sub 2 /, and for CCl/sub 4 /sub 3 /F in Ar. The results of this study led to conclusions relating these parameters to molecular structure. Electron attachment rates were measured also for n-C/sub 4 /sub 6 /F/sub 1 / in both Ar and N/sub 2 /. A study was made of the potential role for electron detachment in breakdown. The roles of several modes of detachment was assessed, especially for SF/sub 6 / and O/sub 2 /sub 2 /. The role of dipolar scattering of electrons in inhibiting breakdown was investigated. The importance of large electron scattering cross sections at subexcitation energies was demonstrated, and means of realizing this with dipolar scattering were studied. The impulse measurements concentrated on n-C/sub 4 /sub 6 /F/sub 8 /-SF/sub 6 / mixtures, which were found to be especially interesting under impulse conditions. Lightning and switching surges were used with a large point-plane gap as well as a sphere-sphere gap. In the practical conditions of cylindrical geometry with and without surface roughness, many multicomponent mixtures of the gases SF/sub 6 /, n-C/sub 4 /sub 6 /F/sub 8 /, N/sub 2 /sub 2 /, and 1,1,1-CH/sub 3 /sub 3 /F/sub 3 / were tested, at both 1 and 4 atmospheres. 40 Refs.  
Primary Keywords: Attachment Rate; Attachment Cross Section; Several Gases; Plane Electrodes; Parallel Electrodes; Sphere-sphere Electrodes; Sensitivity To Field Nonuniformity

4374  
(SWITCHES, CLOSING)  
(Liquid Gaps, Electrical)  
TIME-LAG CHARACTERISTICS OF A LIQUID TRIGATRON  
J.L. Makosiejewski and J.H. Calderwood  
University of Salford, Salford, UK  
Journal Of Physics D: Applied Physics, Vol. 9, No. 17, pp 1195-1198 (12/1976).  
A study was made of the time-lag characteristics of a trigatron spark gap in n-hexane. The influence of the polarity of the triggering pulses and of the gap length was investigated. The significance of the results obtained is discussed. 9 Refs.  
Primary Keywords: Trigatron; N-hexane; Polarity Effects; Variable Gap Spacing; Delay Measurement  
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4377  
(INSUL. 'ON, MATERIAL)  
(Solid)  
COMMENTS ON MANY-BODY DIELECTRIC RELAXATION IN SOLIDS  
A.K. Jons, Jr., L.A. Dissado and R.M. Hill  
Chelsea College, University of London, London, UK  
Phys. Stat. Solidi B, Vol. 102, No. 1, pp. 351-356 (11/1980).  
This paper breaks with previously held views on dielectric relaxation based on non-interacting dipoles or charges and instead develops a model in terms of many-body phenomena. Disorder, occurring at three levels, is presented as a major feature of orientational polarization and thus is an important consideration in the model. The difference between large and small transitions is discussed along with what happens to the energy stored in a solid when the polarization is changed. 9 Refs.  
Primary Keywords: Dielectric Relaxation; Many Body Interaction; Polarization; Dipolar Transitions  
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4379  
(REVIEWS AND CONFERENCES; PARTICLE BEAMS, ELECTRON)  
(Reviews; Reviews)  
ELECTRON-BEAM-FUSION PROGRESS REPORT JANUARY-JUNE 1976  
Authors Unknown  
Sandia Labs, Albuquerque, NM 87115  
Sandia Report No. SAND76-0410 (10/1976).  
Availability: SAND76-0410  
NTIS  
This report presents an overview of the electron beam fusion program at Sandia Laboratories for 1976. Included are brief discussions of progress made in 1976 in switching, water insulated accelerators, Marx generators, water switches, vacuum interfaces, inductive energy storage systems, and magnetically insulated diodes and transmission lines. 90 Refs.  
Primary Keywords: Switch Development; Particle Accelerator; Magnetic Insulation; Marx Generator; Inductive Energy Storage  
Secondary Keywords: E-beam Fusion; Target Design; Plasma Diagnostics

4380  
(REVIEWS AND CONFERENCES; PARTICLE BEAMS)  
(Reviews; Reviews)  
ELECTRON-BEAM-FUSION PROGRESS REPORT JULY THROUGH SEPTEMBER 1976  
Authors Unknown  
Sandia Labs, Albuquerque, NM 87115  
Sandia Report No. SAND76-0711 (05/1977).  
Availability: SAND76-0711  
NTIS  
This report presents an overview of the electron beam fusion program at Sandia Laboratories for 1976. Included are brief discussions of progress made in 1976 in switching, water insulated accelerators, Marx generators, water switches, vacuum interfaces, inductive energy storage systems, and magnetically insulated diodes and transmission lines. 44 Refs.  
Primary Keywords: Marx Generator; Marx Trigger System; Water Capacitors; Transmission Line; Trigatron Gas Switch; Cold Cathode Diode

4381  
(PULSE GENERATORS)  
(Blumlein Lines)  
A BLUMLEIN MODULATOR FOR A TIME-VARYING LOAD  
S. Schneider, M.H. Murphy and A.J. Buffa  
ECOM, Fort Monmouth, NJ 07703  
Technical rept. No. ECOM-4447, 14p (10/1976).  
Availability: AD-A035 102/35T  
NTIS  
A modulator has been built to drive a time-varying-impedance load. A Blumlein circuit, with two identical pulse forming networks, was used to produce an effective voltage of twice the charging voltage. A dissipative clamper circuit was included to simulate a well-behaved load. The switch is a 10 section iterative cavity-grid thyatron designed for 250 kilovolts (kV) and 20 kiloamperes (kA) peak current. The modulator has been operated at 210 kV at a repetition rate of a few hertz (Hz). (Author)  
Primary Keywords: Modulators; Electronic Switches; Thyatrons; High Voltage; Electron Beams; Switching Circuits; Waveform Generators; Chemical Lasers; Deuterium; Pulse Generators  
Secondary Keywords: Blumlein Circuits; High Energy Lasers; NTISDDDA

4382  
(SWITCHES, CLOSING; SWITCHES, CLOSING)  
(Gas Gaps, Electrical; Gas Gaps, Self)  
FERRITE DECOUPLED CROWBAR SPARKGAP  
R.C. Kunze, E.V. Mark, H. Medler and G. Klement  
Institut fur Plasmaphysik, Garching, FRG  
IPP Report No. IPP 6/32 (06/1966).  
Three crowbar sparkgaps are presented each with a different triggering mechanism. The first switch, tested for 8000 discharges on a 2.6 MJ bank, is triggered when the pulse voltage is 1.5 to 2 times the static breakdown voltage which can only occur when the electrodes are decoupled. The second, which also uses ferrite decoupling, is triggered without much jitter by a trigger pulse sent to a middle electrode which is at half potential. The third switch is also triggered by a middle electrode, but does not use ferrite decoupling. The trigger pulse applied to the middle electrode is sharpened allowing the gap to break down to both electrodes at the same time. 9 Refs.  
Primary Keywords: Crowbar Gap; Ferrite Decoupling; Three Triggering Methods



4384  
(PARTICLE BEAMS, ELECTRON)  
(Reviews)  
ISSUES IN UNCLASSIFIED PARTICLE BEAM RESEARCH (PROCEEDINGS OF THE 1980 PARTICLE BEAM RESEARCH WORKSHOP)  
B.D. Guenther (1), R. Lontz (1), J.L. May (2) and C.M. Stickley (3)  
(1) US Army Research Office  
(2) AFOSR, Bolling AFB, Washington, DC 20332  
(3) BDM Corp, McLean, VA  
Availability: AD A0 85158  
NTIS

This workshop is designed to define the important parameters relating to particle beam weapons that require further research. Important parameters in the aspect of pulsed power, charged particle sources, accelerators, propagation, and target interactions are presented, along with necessary research in each area. 0 Refs.  
Primary Keywords: Particle Beam; Electron Beam; Ion Beam

4385  
(REVIEWS AND CONFERENCES; PARTICLE BEAMS, ELECTRON)  
(Reviews; Reviews)  
LASER-FUSION AND ELECTRON-BEAM-FUSION RESEARCH PROGRESS REPORT  
JANUARY-JUNE 1974  
E.M. Beckner, J.B. Gerardo and G. Yonas  
Sandia Labs, Albuquerque, NM 87115  
Sandia Report No. SAND74-0439 (C) 1975.  
Availability: SAND74-0439  
NTIS

This report presents an overview of the laser and electron beam fusion efforts at Sandia Laboratories for the period January-June 1974. Progress on multichannel and dielectric switching, inductive energy stores, self breaking water switching, Marx Generators, gas gap switching, and e-beam diodes are presented. 48 Refs.  
Primary Keywords: Switching; Marx Generator; Liquid Dielectric Switch; Gas Gap; Trigonon; Particle Beam Generation  
Secondary Keywords: E-beam Fusion; Laser Fusion; Plasma Diagnostics

4386  
(PARTICLE BEAMS; POWER CONDITIONING; SWITCHES, CLOSING)  
(Reviews; Pulse Forming Lines; Gas Gaps, Optical)  
PARTICLE BEAM FUSION PROGRESS REPORT APRIL 1978 THROUGH DECEMBER 1978  
Sandia Labs, Albuquerque, NM 87115  
Sandia Report No. SAND79-1011 (12/1979).  
Availability: SAND79-1011  
NTIS

This report provides an overview of the particle beam fusion effort at Sandia Laboratories for the period of April-December 1978. Sections on vacuum diodes, analysis of magnetically insulated transmission lines, Marx generator development, laser and X-ray triggering of spark gaps, and power flow studies are included, as well as sections on plasma diagnostics and fusion target design and analysis. Rep-rated systems are briefly presented. 191 Refs.  
Primary Keywords: EBFA; Proto; E-beam; Marx Generator; Magnetic Insulation; Spark Gap; Power Flow; Resonant Transformer; Rep-rated  
Secondary Keywords: Particle Beam Fusion; Fusion Target; Plasma Diagnostics

4387  
(PARTICLE BEAMS, ELECTRON)  
(Reviews)  
PARTICLE BEAM WEAPONS-A TECHNICAL ASSESSMENT  
G. Baketi, B.T. Feld, J. Permentola and K. Tsipis  
Massachusetts Institute of Technology, Cambridge, MA  
Nature Vol. 284 pp. 219-225 (03/1980).

The authors consider the use of a high energy particle beam as a weapon. The technical problems of generation, propagation, and interaction with a target are addressed. Several examples are given of possible missions that the particle beam could be used for, and the practical aspects of weapons targeting and control are discussed. Both endoatmospheric and exoatmospheric applications are examined. 34 Refs.

Primary Keywords: Particle Beam Weapons; Generation; Propagation; Target Interaction; Beam Requirements  
Secondary Keywords: Orbiting Weapons  
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4388  
(REVIEWS AND CONFERENCES)  
(Reviews)  
PULSED-POWER RESEARCH AND DEVELOPMENT IN THE USSR  
S. Kessel  
The Rand Corp, Santa Monica, CA 90406  
ARPA Report No. R-2212-ARPA (05/1978).  
Availability: AD A056635  
NTIS

The pulsed power work conducted in the Soviet Union from 1960 to 1978 is reviewed in this report. The organizational aspects, as well as the technical side of the open Soviet research is discussed in the areas of electromagnetic compression of liners, flux compression generators, inductive energy storage, homopolar generators, multipolar generators, and opening and closing switches. The principal groups associated with each effort are identified with important results presented. 161 Refs.

Primary Keywords: Flux Compression Generator; Inductive Energy Storage; Superconductivity; Homopolar Generator; Multipolar Generator; MHD Generator; Switching

4389  
(PULSE GENERATORS)  
(Capacitive)  
AN IMPROVED METHOD OF TRIGGERING FLASHLAMPS POWERED FROM AN ENERGY STORAGE INDUCTOR  
E.K. Inell  
Australian National University, Canberra, Australia  
Journal Of Physics E: Scientific Instruments, Vol. 9, No. 5, pp 215-215 (05/1976).  
2 Refs.  
Primary Keywords: Pre-ionize Lamps; Series/parallel Lamps  
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4404  
(BREAKDOWN STUDIES; INSULATION; MATERIAL)  
(Gas, Electrical; Gas)  
GAS, SPARKING POTENTIALS AND IONISATION COEFFICIENTS IN SF/SUB 6/  
V.N. Meller and M.S. Maidu  
Indian Institute of Science, Bangalore, India  
Proceedings Of The IEE, Vol. 123, No. 1, pp 107-108 (01/1976).  
The authors present results of an experiment to determine the ionization coefficients of SF/sub 6/. A deviation from the Paschen Curve is pointed out at pd=1. Comparisons are made with the work of several other researchers. 12 Refs.  
Primary Keywords: SF/sub 6/ Gas; Townsend's Primary Coefficient; Townsend's Secondary Coefficient; Electron-attachment Coefficient  
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4409  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Gas, Optical; Gas Gaps, Optical)  
USE OF A 'LASER SPARK' TO INITIATE A HIGH-POWER HIGH-PRESSURE GAS DISCHARGE  
R.V. Mitin, V.I. Patrenko and Yu.L. Evetskii  
Institute Of Engineering Physics, Academy of Sciences of the USSR, Khar'kov

High Temperature, Vol. 11, No. 6, pp 1026-1028 (12/1973).  
Trans. From: Teorifika Vysokikh Temperatur 11, 1167-1169 (November-December 1973)  
An investigation is made of the initiation of high-pressure discharges in argon using a 'laser spark'. An experimental determination has been made of the threshold breakdown electric field required for laser initiation of high-power gas discharges in argon at pressures up to 100 atm. 7 Refs.  
Primary Keywords: Argon Gas; 100 Atmosphere Pressure Range; Ruby Laser  
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4410  
(PARTICLE BEAMS, ELECTRON; ENERGY STORAGE, INDUCTIVE)  
(Generation; Systems)  
HIGH-CURRENT, HIGH PULSE RATE ELECTRON ACCELERATOR WITH INDUCTIVE ENERGY STORAGE  
V.I. Mikhailov and I.N. Slivkov

Soviet Physics Technical Physics, Vol. 22, No. 6, pp. 703-705 (10/1975).  
The characteristics of a high-current, high-voltage electron accelerator with inductive energy storage and the associated electron-optical system used for electron acceleration and current switching in a storage device are discussed. Accelerators of this kind can be efficient and relatively simple and provide pulse repetition frequencies above 100-200 Hz and at an average power of tens or hundreds of kilowatts. 6 Refs.  
Primary Keywords: Electron Accelerator; Inductive Energy Storage; Electron-Optical Switch  
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4411  
FLOATING DECK GRID MODULATOR  
D.V. Savage

Hughes Aircraft Co, Fullerton, CA  
Final technical rept. Mar 77-May 78 (10/1978).  
Availability: AD-A061 502/157  
NTIS

The all solid state Floating Deck Grid Modulator has been completed and successfully tested. The design goals of pulse width, pulse amplitude, duty cycle, operation in a 50 KV gradient and circuit survival during multiple crowbars of the 50 KV power supply have been met. The rises and fall times are less than 700 nsec. (Author)

Primary Keywords: Traveling Wave Tubes; Pulse Generators; Microwave Tubes; Tube Grids; Radar Transmitters; Pulse Duration Modulation; Pulse Amplitude Modulation; Pulse Transformers  
Secondary Keywords: Modulators; NTISD00XA

4415  
(SWITCHES, CLOSING)  
(Thyratrons)  
PLASMA CATHODE THYRATRON  
D. Fleischer and D. Turnquist  
EG&G Inc, Salem, MA 01970  
ERADOC Report No. DELET-TR-77-2704-1 (09/1978).  
Availability: AD A065048  
NTIS

The objective of this work is to provide a thyratron type device which is capable of cold-start operation; thus eliminating the need for standby power. A replica of a cold-cathode triode, described by Vagin in the Russian literature, was built and tested. The results do not support Vagin's description of its operation. A triode of our own design operates satisfactorily without filament power. A keep-alive or ignitor electrode is proposed as a solution to the high grid breakdown voltage and anode jitter found during the start-up period. 0 Refs.

Primary Keywords: Gas Filled Tube; Switch Tube; Cold Cathode; Instant Start

4419  
(PULSE GENERATORS)  
(Line Type)  
GENERATOR OF HIGH VOLTAGE NANOSECOND PULSES WITH PRECISE LENGTH  
P.S. Anan'in, A.G. Sterligov, V.G. Tolmacheva and Yu.P. Usov  
Tomsk Polytechnic Institute, Tomsk, USSR  
Instruments And Experimental Techniques, No. 4, pp 1115-1117 (08/1970).  
Trans. From: Pribury i Tekhnika Eksperimenta 4, 137-139 (July-August 1970).

A method is described to decrease the amplitude of repeated pulses in a coaxial generator with a spark gap operating into a mismatched load. The length of the pulse on the load is set by a short-circuited section of coaxial cable, where the accuracy with which its length is measured determines the accuracy with which the length of the pulse on the load is set. The generator provides even control of the pulse amplitude from 5 to 15 kV, 0.5 nsec length of the front and trailing edge of the pulse on a matched load, and pulse length to 20 nsec when the amplitude of the repeated pulses is no greater than 5% of the amplitude of the basic pulse. The generator is designed to supply the electron optic shutter in an optic quantum generator. 5 Refs.  
Primary Keywords: Pulse Generator; Coaxial Line Energy Storage; Variable Pulse Length; Small Trailing Pulses  
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#### 4427 (PARTICLE BEAMS, ELECTRON)

(Generation)  
ANALYSIS OF COUPLING REGION IN TRANSMISSION-LINE ACCELERATORS  
J.K. Temporey  
Army Amament Research and Development Command, Aberdeen Proving Ground  
MD 21005  
ARRL Report No. ARRL-TR-02120 (11/1978).  
Availability: AD A063463  
NTIS

A Laplace-transform analysis is presented of an equivalent circuit which represents a pair of asymmetric transmission lines coupled through a reentrant discontinuity. This cavity configuration is applicable for transmission-line accelerator designs. General expressions for the time-dependent open-circuit output voltage are derived. Some numerical examples for specific line geometries are presented. 7 Refs.

Primary Keywords: Electron Accelerator; Transmission-line; Asymmetric Transmission-line Pairs; Reentrant Transmission-line Discontinuity; Laplace Transform

#### 4428 (DIAGNOSTICS AND INSTRUMENTATION)

(Voltage)  
AN ELECTRO-OPTIC, HIGH-VOLTAGE, TRANSIENT PROBE  
S.J. Posta and C.J. Michels  
Lewis Research Center, Cleveland, OH  
NASA Technical Memorandum Report No. 79019 (10/1978).  
Availability: N79-12416  
NTIS

A differential electro-optic voltage probe is described to measure transient differential high voltages in the range of 10 to 20 kV and 10 to 150 ns. This probe was designed to measure the voltage applied to a laser and an electro-optical device was chosen to reduce noise and to minimize problems associated with ground loops in the circuit. Common mode rejection techniques were applied to the probe to reduce common mode noise. The probe consists of a LED with an input resistor which allows a current to flow in the LED that is proportional to the input voltage. The output of the LED is routed, via fiber optic to a remote photomultiplier and associated measuring equipment. A small bias is applied to the LED through a balanced network (to provide common mode rejection) to allow small reverse voltages to be measured. The probe was calibrated using a 2 kV pulser with a 1-10 step-up transformer for amplitude measurements and the same 2 kV pulser with a fast rise amplifier for the rise time measurements. The probe was found to be less noisy with better common mode rejection than the electrical probe used previously. 5 Refs.

Primary Keywords: Electro-optic Probe; Fast Rise; High Noise Rejection; High Common Mode Rejection; Simple Design

#### 4429 (BREAKDOWN STUDIES; INSULATION, MATERIAL)

(Solid, Electrical; Solid)  
A PROGRAMMABLE D-C HIGH-VOLTAGE RAMPED TEST SYSTEM FOR ELECTRICAL INSULATION

U. Milano  
Bureau Of Reclamation, Denver, CO 80225  
Bureau Of Reclamation Report No. REC ERC-78-7 (10/1978).  
Availability: PB 290495  
NTIS

A technique is presented that uses a programmable DC high-voltage test set to automatically ramp the high voltage at a preselected rate while continuously recording the resultant rotating machinery stator insulation current. The principal advantage of the ramp testing technique over the conventional stepped method is the greatly improved sensitivity and accuracy of the test results. In addition, the ramp test requires only one person to run the test and provides that person with better control and sufficient lead time when a failure point is approached to avoid damaging the insulation. A full description of the test technique, interpretation of test results, and test set operation are included. 3 Refs.

Primary Keywords: Insulation Breakdown Strength; Ramp Test; Rotating Machine; Non-destructive Test

#### 4431 (DIAGNOSTICS AND INSTRUMENTATION)

(Systems)  
ONLINE DATA ACQUISITION SYSTEM FOR REPETITIVE PULSER DEVELOPMENT

M.T. Buttram  
Sandia Labs, Albuquerque, NM 87115  
(09/1978).  
Availability: SAND 78 1755  
NTIS

The computer system currently online to the RIF-1, a one hundred pulse per second, 75 kV, 100 ns, is described. This system partially analyzes data as received to provide real-time, online diagnostic information about the performance of RIF-1. The system is based on CAMAC, a set of conventions for the transfer of data between a computer and experimental modules. The computer for this facility is a PDP 11-34; the interface between computer and experimental modules is itself a microcomputer. A variety of experimental modules is used. The computer stores all incoming data on tape for subsequent complete analysis, if desired, performs a real time partial analysis, and provides displays as requested. The interface controls the transfer of data between experimental modules and the PDP-11 computer. The input modules were chosen to acquire a few digital words per pulse which, when collected into statistical ensembles, characterize RIF-1 operation. Time digitizers and analog-to-digital converters are currently being used. The system has the capability of providing active computer control should that become desirable. 14 Figures, 6 Tables (DRA citation 04 016975)

Primary Keywords: Beam Pulser; Electrostatic Accelerator; High Voltage Pulse Generator; Pulse System; Data Acquisition Systems; Electronics; Fortran; On Line Measurement Systems; Pdp Computers  
Secondary Keywords: TPD474500, NT1501

#### 4434 (TRIGGERING OF A HIGH VOLTAGE PULSE SHAPER FOR IMPROVING TIME STABILITY AND AMPLITUDE STABILITY)

E. Deiters, G. Peter, A. F. Schmitt, R. Trautzbach and T. V. Grishkevich  
Deutsche Akademie der Wissenschaften zu Berlin, Zoolingen, GDR  
(01/1976).  
Availability: PRE 76 15  
NTIS

Triggering of a transformer powered Blumlein line with a N sub 2 laser and a trigger pin (Triggerpin) is described. Stability of the amplitudes of delta U/U and time jitter  $\Delta t/t$  are available. Advantages and disadvantages of both methods are discussed. (Atomizer citation 01 194548)

Primary Keywords: High Voltage Pulse Generator; Transformer Spark Chambers; Amplitude; Laser; Pulse Rise Time; Pulse Shapers; Stability; Trigger Pin  
Secondary Keywords: Laser; Transformer Spark Chambers; Blumlein Line; Distribution; Rectifier; Trigger Pin

#### 4440 (SWITCHES, CLOSING)

(Gas Gaps, Optical)  
A MULTICHANNEL LASER TRIGGERED SPARK GAP WITH SUBNANOSECOND RISE TIME FOR ELECTRO-OPTIC SWITCHING

C.L.M. Ireland  
Atomic Weapons Research Establishment, Aldermaston, Berkshire, UK  
Journal Of Physics L, Vol. 8, pp 1007-1010 (07/1975).

The construction and some of the operating characteristics of a multichannel, laser triggered spark gap (LTSG) are described. Simultaneous subnanosecond switching in five channels of up to 10 kV is possible, making the LTSG an ideal master switch for pulsing Pockel cells to control the pulse shape and isolation necessary in a large laser oscillator amplifier system. Operated under N sub 2 at a pressure of approximately 10 kbar, the LTSG had a rise time <300 ps and used in conjunction with a fast Pockel cell switch could shutter reliably optical pulses of <500 ns duration from the output of a Q-switched laser. The results indicate that at higher pressure the rise time of the LTSG should be further reduced allowing switching in approximately 100 pps to be achieved. 11 Refs.

Primary Keywords: Coaxial Spark Gap; Nitrogen Gas; Variable Pressure; Multichannel Operation; Five Channels; 300 Picosecond Rise Time; High Pressure Gap  
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#### 4444 (SWITCHES, CLOSING)

(Gas Gaps, Electrical)  
A THREE GAP SPARK DISCHARGE DEVICE FOR SUPPLYING SPARK CHAMBERS

G.D. Alakheev and D.M. Phazins  
Joint Institute Of Nuclear Research, Dubna, USSR  
Instruments And Experimental Techniques, Vol. 18, No. 5, pp 1447-1449 (10/1975).

Trans. From: Pribury i Tekhnika Eksperimenta 5, 105-106 (September-October 1975)

A three-gap air spark-discharge device was investigated. The device is efficient over a wide range of supply voltages, it has an actuation delay of 30 to 60 nsec, depending on the supply voltage; the scatter of the delay is 7-15 nsec, the duration of the leading edge of the output pulse is approximately 10 nsec. The spark-discharge device is reliable in operation, has a long service life, and is simple to fabricate. 5 Refs.

Primary Keywords: Spark Gap; Air Gap; Self-crowbaring; 7-15 ns Jitter; Long Life; Low Current  
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#### 4456 (INSULATION, MATERIAL)

(Solid)  
DISTRIBUTION OF SURFACE CHARGES ON PERSPEX DUE TO PARTIAL DISCHARGES

S. Indrakshi and V. Prabhaskar  
Indian Institute Of Science, Bangalore, India  
Journal Of Applied Physics, Vol. 9, No. 6, pp 987-997 (04/1976).

11 Refs  
Primary Keywords: Perspex Air Insulation; Partial Discharge; Corona Inception; Surface Tracking; Puncture  
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#### 4460 (BREAKDOWN STUDIES)

(Electrodes)  
EROSION OF METAL CATHODES BY ARCS AND BREAKDOWNS IN VACUUM

E. Hantzsche (1), R. Juttner (1), V.I. Puchkarov (2), M. Rohrbeck (1) and H. Wolf (1)

(1) Akademie Der Wissenschaften Der DDR, Zentralinstitut Fur Elektronenphysik, Berlin, GDR  
(2) Siberian Department Of The Academy Of Science Of The USSR, Tomsk, USSR  
Journal Of Physics D: Applied Physics, Vol. 9, No. 12, pp 1771-1781 (08/1976).

19 Refs.  
Primary Keywords: Metal Cathodes; Erosion Structure; Nanosecond Breakdowns; Quasi-stationary Arcs; Crater Formation Types; Microspont Explosions; Cathode Spots; Field Emission; Ion Pressure  
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#### 4474 (BREAKDOWN STUDIES)

(Gas, Electrical)  
INFLUENCE OF RAIN ON SWITCHING IMPULSE SPARKOVER VOLTAGE OF LARGE-ELECTRODE AIR GAPS

A.M. Rizk  
Hydro Quebec Institute Of Research, Verennes, Quebec, Canada  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS 93, No. 4, pp 1346-1347 (08/1976).

The paper deals with a laboratory investigation into the influence of rain on the switching impulse sparkover characteristics of large sphere and forced plane air gaps. Tests were also carried out on one terminated rod plane gaps for reference purposes. The factors investigated include the high voltage electrode geometry, nature of the surface, rain intensity as well as the impulse form and polarity. Attention is also paid to the influence of rain on the statistical dispersion of the sparkover voltage and on the nature of the cumulative probability curve. A general correlation, valid for a wide variety of electrode, has been established between the mean sparkover voltage gradient for positive switching impulses under dry conditions, and the corresponding influence of rain on the breakdown voltage. 19 Refs.

Primary Keywords: Humidity Influence; Air Gap; Sphere sphere Gap; Termination; Geometry Effects  
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#### 4481 (BREAKDOWN STUDIES)

(Surface Flashover)  
ON THE CONDITIONING PHENOMENA OF SURFACE FLASHOVER OF EPOXY RESINS IN A VACUUM

Y. Ohki and K. Yabagi  
Waseda University, Tokyo, Japan  
Japanese Journal Of Applied Physics, Vol. 15, No. 1, pp 177-178 (01/1976).

Experiments were done which studied the flashover of epoxy resins in a vacuum. Conditioning effects were noted with the epoxy resin dielectric and without it. Seven types of resin were used so that the effect of the benzene ring on breakdown voltage could be examined. 5 Refs.

Primary Keywords: Surface Flashover; Conditioning; Electrode Effect; Several Samples; Similar Behavior  
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4489  
(PULSE GENERATORS; POWER CONDITIONING; PARTICLE BEAMS; ELECTRON)  
(Systems; Pulse Transformers; Generation)  
RELATIVISTIC ELECTRON BEAM SOURCE WITH AN AIR-CORE STEP-UP TRANSFORMER  
A. Mohri, K. Ikuta, M. Masuzaki, T. Tsuzuki, S. Fujiwaka, K. Ukegawa  
and T. Kato  
Nagoya University, Nagoya, Japan  
Japanese Journal Of Applied Physics, Vol. 14, No. 11, pp 1777-1781  
(11/1975).  
A design for a high current relativistic electron beam source  
using an air-core step-up transformer is presented. The step-up ratio  
was greater than 10 and the energy transfer efficiency from the  
capacitor bank to the pulse forming line was 43%. The machine proved  
to be reliable as it required little maintenance during the 5000  
times it was operated without major trouble. 13 Refs.  
Primary Keywords: Vacuum Diode; Marx Generator; Pulse Transformer;  
Pulse Forming Line; Impedance Conversion  
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4492  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
STARTING CHARACTERISTICS OF A 100-KV TRIGATRON FILLED WITH SF/SUB 6/  
A.I. Gersimov, G.D. Kuleshov, A.I. Pavlovskii, S.Ya. Silyusarenko and  
A.S. Fedotkin  
Instruments And Experimental Techniques, Vol. 18, No. 5, pp 1435-1437  
(10/1975).  
Trans. From: Pribyori i Tekhnika Eksperimenta 5, 111-113  
(September-October 1975)  
An experimental investigation was made of the delay and scatter of  
the time required to turn on a trigatron as a function of the  
polarity of the high-voltage electrode and of the control-voltage  
pulse, on the amplitude of the pulse, and on the SF/sub 6/ pressure.  
The distance between the main trigatron electrodes is 2 mm; the  
diameter of the control electrode is 2 mm; the annular gap between  
the control electrode and the main electrode which encompasses it is  
2.5 mm. It is shown that for a negative potential of the high-voltage  
electrode and a positive starting pulse, the scatter of the actuation  
time delay does not exceed 10 nsec in the range of pressure  
variations from the value corresponding to uncontrollable breakdown  
at 100 kV up to a pressure five times as great (15 atm). 1 Refs.  
Primary Keywords: Trigonon; SF/sub 6/ Gap; Switching Delay; Both  
Polarities; Variable Gas Pressure; Variable Trigger  
Voltage; 100 kV Operating Voltage  
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4501  
(SWITCHES, CLOSING)  
(Gas Gaps, Optical)  
UV LASER TRIGGERING OF SPARK GAPS BY TWO-QUANTUM PHOTOELECTRIC EFFECT  
K. Harsch, H. Salzmann and H. Strohwald  
University of Stuttgart, Stuttgart, FRG  
Physics Letters, Vol. 55A, No. 3, pp 153-154 (12/1975).  
A nitrogen laser is utilized to irradiate an aluminum cathode in  
an attempt to isolate the ionization mechanism of UV laser triggering  
of spark gaps. The two mechanisms considered are Richardson emission  
and photoelectric emission. The gap was evacuated during the study to  
prevent breakdown, enabling study of the electron emission from the  
cathode in detail. The authors present evidence for two photon  
photoelectric emission of electrons from the cathode as the primary  
triggering mechanism. 8 Refs.  
Primary Keywords: Nitrogen Laser; Aluminum Cathode; Richardson Effect;  
Photoelectric Emission; Two-photon Effect; Spark  
Gap; Vacuum Gap  
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4530  
(POWER CONDITIONING)  
(Pulse Forming Networks)  
SCEPTRE MODELS OF A PULSE FORMING SYSTEM  
R.J. Kuhler and V.J. Watson  
University of Kentucky, Lexington, KY 40506  
RADC Report No. RADC-TR-75-65 (03/1975).  
Availability: AD A009175  
NTIS  
Work performed in the generation and testing of the pulse forming  
network SCEPTRE model, is discussed with emphasis upon attempts to  
determine the pulse forming network element stressing factors under  
conditions of specific fault occurrences: pulse transformer failure  
via secondary short or load short; secondary open; and pulse forming  
network capacitance short. When the generator model is available, the  
composite system can be simulated to determine the result of  
transient and fault conditions on the overall network operation. 0  
Refs.  
Primary Keywords: Pulse Forming Network; SCEPTRE Computer Code; Fault  
Modeling; Electromagnetic Compatibility

4537  
THE VEBA RELATIVISTIC ELECTRON ACCELERATOR  
R.K. Parker and M. Ury  
Naval Research Lab, Washington, DC 20375  
Interim rept. No. NRL-MR-3056, 19p (05/1975).  
Availability: AD A015 188/85T  
NTIS  
The VEBA high-current, relativistic electron accelerator has been  
designed and constructed at NRL for application in the study of high  
power microwave sources. To meet the requirements of this study, the  
accelerator was designed for operation in either a short (60 nsec) or  
long (2.2 microsec) pulse mode. The pulse-forming network in the  
short-pulse mode is an unbalanced water Blumlein with an output  
impedance of 9.1 ohms. The Blumlein is pulse-charged by a 1.9 MV Marx  
generator which has a series capacitance of 26 nF. By transmission  
along a tapered coaxial line, the output pulse is transformed to 20  
ohms and the voltage developed across the diode increased to 2 MV.  
The Blumlein and transformer sections are removed to convert to the  
long pulse mode, and the diode is attached directly to the oversized  
Marx tank. The direct coupling between the Marx and the Blumlein is  
then replaced by two nested water capacitors which are shunted by  
spiral inductors. This unit with the Marx forms a three-section,  
voltage-fed, Guillemin (type A), pulse-forming network with a  
characteristic impedance of 40 ohms and an output voltage of 1 MV.  
Primary Keywords: Electron Accelerators; Microwaves; Pulse Generators;  
Diodes; Sources  
Secondary Keywords: NTIS000NRL

4540  
(ENERGY CONVERSION, ELECTRICAL; INSULATION, MATERIAL)  
(Power Supplies; Liquid)  
A HIGH VOLTAGE SOURCE WITH DIGITAL CONTROL FOR DIELECTRIC MEASUREMENTS  
A.R. Reichert, G.M. Rhodes and J.E. Brignell  
City University, London, EC1, UK  
Journal Of Physics E: Scientific Instruments, Vol. 5, pp 587-590  
(06/1972).  
An improvement in the rigorous control of high voltages for  
dielectric measurements is achieved by employing digital techniques  
in the development of a low-voltage controller for a generator of  
either the oscillator or electrostatic type. Principal advantages  
over a method previously described are the provision of a highly  
stable hold mode and the capability for very slow rates of voltage  
application. Comprehensive logic controls, incorporating essential  
safety features, allow fully automatic experiments to be performed,  
and a flexible design permits a simple addition to the equipment to  
increase the resolution if desired. 7 Refs.  
Primary Keywords: Insulation Tester; Ramp Voltage Generator; Digital  
Control; High Voltage Accuracy  
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4547  
(SWITCHES, CLOSING)  
(Liquid Gaps, Optical)  
A HIGH-VOLTAGE WATER SPARK GAP WITH LASER FIRING  
B.A. Davydov, M.V. Ivkin, V.A. Petrov and S.D. Fanchenko  
Instruments And Experimental Techniques, Vol. 17, pp 131-133 (02/1974).  
Trans. From: Pribyori i Tekhnika Eksperimenta 1, 120-122  
(January-February 1974)  
The possibility is investigated of initiating high-voltage  
breakdown of distilled water in a spark gap by means of a spark from  
a neodymium laser having a power of up to 500 MW. It is shown that  
for focusing of laser radiation onto the positively charged electrode  
the scatter of the actuation time of the spark gap amounts to several  
nanoseconds. A spark gap construction was proposed which ensures  
reliable firing of the discharge for any polarity of the voltage  
across the electrodes. 6 Refs.  
Primary Keywords: Nd Laser; Polarity Effects; Several Nanosecond Jitter  
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4552  
(PULSE GENERATORS; BREAKDOWN STUDIES)  
(Marx; Vacuum, Electrical)  
A 2-MV PULSED ELECTROVACUUM INSTALLATION  
J.I. Kalyatskii, G.M. Kassirov and G.V. Smirnov  
Tomsk Polytechnic Institute, Tomsk, USSR  
Instruments And Experimental Techniques, Vol. 17, No. 4, pp 1032-1034  
(08/1974).  
Trans. From: Pribyori i Tekhnika Eksperimenta 1, 84-86 (July-August  
1974)  
An experimental installation is described for investigating  
electrical breakdown in a vacuum of up to  $10^{-5}$  Torr at pulse voltages  
of up to 2 MV. The length of the vacuum gap reaches 16 cm. 4 Refs.  
Primary Keywords: Vacuum Breakdown Study; Apparatus Description;  
Experimental Results; Aluminum Electrodes;  
Sphere-plane Gap  
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4565  
(PARTICLE BEAMS, MACRO; BREAKDOWN STUDIES)  
(Generation; Vacuum, Particle)  
MICROPARTICLE ENERGY ENHANCEMENT FOLLOWING A BOUNCING IMPACT IN A  
HIGH-VOLTAGE GAP  
A.S. Brah and R.V. Latham  
University of Aston, Birmingham, Birmingham B4 7ET, UK  
Journal Of Physics D: Applied Physics, Vol. 8, No. 8, pp L109-L111  
(06/1975).  
A low-velocity microparticle gun has been developed for a  
controlled study of the momentum and charge reversal associated with  
particle bouncing in a high-voltage vacuum gap for impact velocities  
of 5-200 m/s. It has been demonstrated that there are a range of  
experimental conditions for which this mechanism can lead to an  
enhancement in the kinetic energy of a microparticle. This  
observation is used in support of a multi-transit model for the  
initiation of electrical breakdown by the impact of microparticles  
having velocities in excess of 1500 m/s. 12 Refs.  
Primary Keywords: Microparticle; Acceleration; Momentum Transfer;  
Charge Reversal; Vacuum Breakdown; Multi-transit  
Model  
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4570  
(PARTICLE BEAMS, ELECTRON; POWER CONDITIONING; PULSE GENERATORS)  
(Generation; Pulse Transformers, Systems)  
RESONANT TRANSFORMER ELECTRON BEAM PULSER  
J.J. Moriarty  
Energy Sciences Inc., Burlington, MA 01803  
AFRL Report No. AFRL-TR-74-122 (11/1974).  
Availability: AD A001828  
NTIS  
A resonant air-core transformer has been evaluated theoretically  
and experimentally as a pulser for an electron beam gun. The analysis  
has resulted in a set of design parameters which has been used to  
design a lightweight (approximately 100 kg) pulser for the generation  
of 150 kV, 40-A pulses of 30 microsecond duration at 250 pps in  
10-sec bursts. An experimental model has generated 150-kV, 2 to 5-A  
pulses of 10 to 16 microsecond duration at 20 pps in operation  
limited by the available power supply. Experimental results have been  
in sufficient agreement with the theory to provide a high level of  
confidence in the full scale design. The efficiency predicted in the  
simplified case of decoupled losses varies from 42 percent with  
resistive charging to 36 percent by reactive charging methods. In  
general, the DC-to-beam efficiency improves as the loading is  
increased and may approach 60 percent in view of the coupling which  
realistically exists between loss elements. 7 Refs.  
Primary Keywords: Resonant Air-core Pulse Transformer; E-beam  
Generation; Light Weight; Rep-rated; Experiment;  
Theory; Design Considerations

4572  
(PARTICLE BEAMS, ELECTRON; ENERGY STORAGE, INDUCTIVE)  
(Generation, System)  
SHAPING OF VOLTAGE PULSES BY DISCHARGING AN INDUCTIVE STORAGE BANK WITH  
A CHARGED-PARTICLE BEAM  
O.A. Gusev, E.G. Komer, V.B. Markov and E.M. Mellokh  
D.V. Efremov Institute, Leningrad, USSR  
Soviet Phys. Technical Physics, Vol. 19, No. 5, pp 662-663 (11/1974).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 44, 1051-1054 (May 1974).  
Calculations and experimental data are reported on the conditions  
for the formation of a rectangular accelerating-voltage pulse in a  
direct-action charged-particle accelerator in which energy is  
supplied from an inductive bank. 2 Refs.  
Primary Keywords: E-beam Generation; Inductive Energy Store; Matching  
Condition; Current Regulation; Impedance Calculation  
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PERMISSION

4581  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Gas, Electrical; Gas Gaps, Materials)  
THE RECOVERY OF HIGH CURRENT LONG GAPS IN HYDROGEN AND ARGON  
R. Simons and J.B. Parker  
University of Liverpool, Liverpool, UK  
International Journal of Electronics, Vol. 37, No. 6, pp 825-832  
(01/1974).  
Dielectric recovery voltages of high current long gaps (8 cm) in  
hydrogen and argon are investigated. Temperature profile of the gap  
is given along with values of temperature versus time. Recovery  
curves calculated from measurements were found to differ greatly from  
derived recovery curves. Explanations for the differences are  
discussed. 11 Refs.  
Primary Keywords: Spark Channel Recovery; Argon; Hydrogen; Temporal  
Variation Of Temperature; Radial Variation Of  
Temperature  
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4590  
(SWITCHES, CLOSING)  
(Gas Gaps, Optical)  
A DYE LASER TRIGGERED SPARK GAP  
K. Schildbach and D. Basting  
Max-Planck-Institut für Biophysikalische Chemie, Göttingen, BDR, Germany  
The Review Of Scientific Instruments, Vol. 45, No. 8, pp 1015-1016  
(08/1974).  
Performance of a dye laser triggered spark gap is described with a  
triggering threshold of only 2 mW peak power and 5 microjoules pulse  
energy. This spark gap is used as a switching element in a nitrogen  
laser resulting in a delay between dye laser and nitrogen laser  
emission of only 20 nsec and a subnanosecond jitter. 5 Refs.  
Primary Keywords: Dye Laser; Low Power; Very Low Energy; Tungsten  
Electrode; Subnanosecond Jitter  
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PERMISSION

4592  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
A PICOSECOND RISETIME HIGH VOLTAGE DIVIDER  
D.G. Pellinen (1), Q. Johnson (2) and A. Mitchell (2)  
(1) Physic International Co, San Leandro, CA 94577  
(2) Lawrence Livermore Lab, Livermore, CA 94550  
The Review Of Scientific Instruments, Vol. 45, No. 7, pp 944-946  
(07/1974).  
A two-stage voltage divider having a voltage measuring capability  
on the order of 100 kV and a rise time of 250 psec has been used to  
measure submicrosecond pulses on a pulsed electron accelerator. The  
divider uses a copper sulphate solution high-voltage divider, and a  
secondary divider made of carbon composition resistors. Measurements  
have been made indicating the solution divider is useful with fields  
of 30 kV/cm and with subnanosecond rise times. 4 Refs.  
Primary Keywords: Capacitor Voltage Divider; Resistive Divider; Copper  
Sulphate Resistor; Carbon Resistor; 100 kV Vc Range  
Range; 250 ps Rise Time  
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4593  
(SWITCHES, CLOSING)  
(Vacuum Gaps, Optical)  
A VACUUM SPARK GAP WITH LASER FIRING  
A.A. Malknevich and V.A. Rodchik  
Scientific-Research Institute Of Electro-Physical Equipment, Leningrad,  
USSR  
Instruments And Experimental Techniques, Vol. 16, No. 6, pp 1716-1717  
(12/1973).  
Trans. From: Pribury i Tekhnika Eksperimenta 6, 98-92  
(November-December 1973).  
A vacuum (approximately 1E6-1E13 Torr) spark gap operating at a  
voltage of up to 50 kV is described which is fired by a Q switched  
ruby laser. The time delay of spark-gap breakdown was measured at  
various computed voltages, various pressures, and different  
polarities of the target electrode. The possibility of using the  
spark gap in circuits for shaping nanosecond pulses is evaluated. 3  
Refs.  
Primary Keywords: Ruby Laser; 50 kV Voltage Range; Time Delay  
Measurement; Plane Electrodes; Nanosecond Jitter  
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4626  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
MEASUREMENT OF A HIGH VOLTAGE BY A ROTOR VOLTMETER USING AN INSULATED  
ELECTRODE  
M.T. Novikov  
Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR,  
Khar'kov, USSR  
Instruments And Experimental Techniques, Vol. 16, No. 5, pp 1591-1592  
(10/1973).  
Trans. From: Pribury i Tekhnika Eksperimenta 5, 247-248  
(September-October 1973).  
The possibility and singularities of the measurement of a high  
voltage by a rotor voltmeter when the electric field from the  
high-voltage electrode is brought out to the voltmeter by means of an  
insulated measurement electrode are demonstrated experimentally. The  
measurements were carried out at voltages of 0 to 50 kV. 2 Refs.  
Primary Keywords: Rotor Voltmeter; DC Voltage Measurement; 50 kV  
Operating Voltage; High Reliability  
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4640  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
ION-INDUCED PINCH AND THE ENHANCEMENT OF ION CURRENT BY PINCHED  
ELECTRON FLOW IN RELATIVISTIC DIODES  
S.A. Goldstein (1) and R. Lee (2)  
(1) University of Maryland, College Park, MD 20742  
(2) Naval Research Lab, Washington, DC 20375  
Physical Review Letters, Vol. 35, No. 16, pp 1079-1082 (10/1975).  
A new model for time-dependent and steady-state ion and electron  
flow in large-aspect-ratio diodes is constructed. The electron  
trajectories are computed with use of the self-consistent fields  
calculated during the initial ion motion. The dynamic formation of a  
tightly pinched electron flow is qualitatively explained. Very large  
ion currents, nearly equal to the electron current, are predicted for  
flat solid cathodes when steady-state flow is achieved. 8 Refs.  
Primary Keywords: E-beam Generation; Large Aspect Ratio Diode; Flat  
Solid Cathode; Ion Current; Electron Current; Pinched Electron Flow  
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4641  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
ROTARY SPARK GAP SWITCHING FOR HIGH POWER DYE LASERS  
C.M. Ferrer  
United Aircraft Research Labs, East Hartford, CT 06108  
Applied Optics, Vol. 13, No. 9, pp 1998-1999 (09/1974).  
A rotary spark gap is used in series with a flashlamp to provide  
the necessary voltage holdoff between pulses. The gap was tested up  
to 150 pps with the flashlamp pumped dye laser reaching a maximum  
output of 39W at 110 pps. Possible gap improvements are discussed. 5  
Refs.  
Primary Keywords: Rotary Spark Gap; Rep-rated; Short Recovery Time;  
High Gap Inductance  
Secondary Keywords: Dye Laser Pumping  
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4644  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
SIMPLE SPARK GAP FOR A HIGH REPETITION RATE NITROGEN LASER  
L. Pallero, R. Pelloni and F. Zeraga  
Lab di Fisica del Plasma ed Elettronica Quantistica del CNR, Milan,  
Italy  
Optics and Laser Technology, Vol. 6, No. 4, pp 1 (03/1974).  
A simple and inexpensive 30 kV spark gap capable of repetition  
rates up to 100 Hz is presented. It uses, among other things, the  
terminal external part of a spark plug of a car as the trigger  
electrode. 5 Refs.  
Primary Keywords: Spark Gap; Simple Design; Medium Voltage; High  
Reliability; Rep-rated  
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4660  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
VARIATION OF ION DENSITY IN A HIGH-VOLTAGE LABORATORY DURING  
IMPULSE-VOLTAGE TESTING  
T.E. Allibone and D. Dring  
Leeds University, Leeds, UK  
Proceedings Of The IEE, Vol. 121, No. 5, pp 401-402 (05/1974).  
The measurement of ions in the vicinity of a gas breakdown gap  
with and without stabilizing radiation is described. The time of  
decay to background level is reported, as well as effects of nearby  
high-voltage equipment. 5 Refs.  
Primary Keywords: Ambient Ionization Level; Radiation; DC Voltage;  
Impulse Voltage; Decay Time  
COPYRIGHT: 1974 IEE

4679  
(REVIEWS AND CONFERENCES)  
(Conferences)  
1976 IEEE PULSED POWER CONFERENCE PROCEEDINGS  
Conference Record (11/1976).  
This conference record contains 97 papers (9 are included as  
abstracts only), all of which are referenced individually in the  
bibliography. Topics include energy storage, pulse generation, pulse  
shaping, switching, particle beam generation and transport,  
applications, and reviews of the state-of-the-art. 0 Refs.  
Primary Keywords: Energy Storage; Pulse Generation; Pulse Shaping;  
Switching; Particle Beam Generation And Transport;  
Applications  
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4680  
(PULSE GENERATORS; ENERGY CONVERSION, ELECTRICAL)  
(Line Type; Charging Circuits)  
AN AMENDED LINE-TYPE PULSE GENERATOR CIRCUIT  
G. Scoles  
English Electric Valve Co Ltd, Chelmsford, Essex, UK  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIIB-6 (11/1976).  
Over the years line-type pulse generators have tended to become  
standardised and in the majority of modern circuits a pulse-forming  
network is charged sinusoidally to twice the supply voltage and  
then discharged into a substantially matched load to generate an  
output pulse. The variant described in this paper is similar, except  
that instead of connecting one terminal of the load to the common  
negative busbar, it is connected to the high tension terminal of the  
capacitor forming the reservoir of the power supply. This halves the  
voltage to which the PFN is charged and several advantages accrue  
from the change. These are, in a few cases, offset by the use of a  
floating load, although a correctly designed pulse transformer  
largely obviates this. The advantages and disadvantages of the  
circuit are discussed, showing that in many applications its use  
results in lower capital cost and more certain recovery of the  
switching device. 0 Refs.  
Primary Keywords: Line Type Pulse Generator; PFN Charging Method  
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4681  
(ENERGY STORAGE, MECHANICAL; PULSE GENERATORS)  
(Rotating Machines; Rotating Machines)  
AN ELECTROMECHANICAL PULSE GENERATOR

J.P. Craig and R. Saeks  
Texas Tech University, Lubbock, TX 79409  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIB-7 (11/1976).  
A prime pole generator has been conceived and designed and a low power model has been built and tested. The machine produces one large positive pulse per revolution and a number of small, equal magnitude negative pulses per revolution depending upon the number of poles. Any prime number of poles can be used, with one zero-strength pole and an equal number of equal strength north and south poles. The pole pattern can be determined from a Legendre Sequence. 0 Refs.  
Primary Keywords: Prime Pole Generator; Rep-rate; Legendre Sequence  
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4682  
(ENERGY STORAGE, CAPACITIVE)  
(Systems)

A DESIGN APPROACH TO A REPETITIVELY PULSED SUPER FAST CAPACITOR BANK  
D. Zucker (1), J. Long (1) and M. Bostick (2)  
(1) Lawrence Livermore Lab, Livermore, CA 94550  
(2) Stevens Institute of Technology, Hoboken, NJ 07030  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIC-4 (11/1976).  
Repetitively pulsed super fast banks suffer from the following problems: On the one hand, long life necessitates low fields. On the other hand, high fields are necessary to shrink down the volume of the total system and thus, the inductance. Here we are describing an approach that tries to optimize as much as possible, these two conflicting requirements in a design for a megajoule capacitor bank capable of pulsing ten million shots or above, at a minimum of one pulse in a second. Problems such as current crowding in the capacitor bank, switching, heat removal, poyntig vector flow surface to volume considerations, energy recycling and foil design will all be discussed. Specific design parameters and final dimensions will be presented.  
Primary Keywords: Super Fast Capacitor Banks; Long Life; Low Inductance  
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4683  
(POWER CONDITIONING)  
(Pulse Forming Networks)

A HALF MEGAWATT PULSE FORMING NETWORK  
J.E. Creason (1) and R.A. Fitch (2)  
(1) ECOM, Fort Monmouth, NJ 07703  
(2) Maxwell Labs Inc, San Diego, CA 92123  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIIB-1 (11/1976).  
A lightweight half megawatt average power pulse forming network designed to store 4 kilojoules at 40 kilovolts has been developed. The energy storage system produces a 10 microsecond pulse at a repetition rate of 125 hertz and has a one ohm impedance. It is designed to operate adiabatically for durations of 60 seconds. A lifetime capability of over 465 pulses has been demonstrated. 0 Refs.  
Primary Keywords: Pulse Forming Network; Rep-rate; Burst Mode; High Average Power; Adiabatic Operation  
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4684  
(ENERGY CONVERSION, ELECTRICAL)  
(Power Supplies)

A HIGH VOLTAGE D-C REGULATOR SYSTEM PERFORMANCE PREDICTION TECHNIQUE  
C.J. Eichenauer Jr.  
General Electric Co, Syracuse, NY 13201  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIIC-6 (11/1976).  
The DC beam accelerating voltage applied between the cathode and the slow wave structure of a traveling wave amplifier tube must often be held to within a few hundredths of one percent of its specified value if acceptable R-F phase stability is to be obtained from the amplifier. In high power pulsed radar applications this d-c voltage may be on the order of 40 kilovolts, hence the requirement for a precisely controlled high voltage regulated power supply with excellent transient response typically results. Since the construction of a breadboard model of such a system is usually impractical from both schedule and cost points of view, a reliable means of analytical performance prediction is of considerable importance. The CIRCUS 2 computer aided design program was used for this analysis. The techniques described are equally applicable to many current requirements, for example, neutral beam pulse regulator systems. 0 Refs.  
Primary Keywords: Excellent Voltage Regulation; Good Transient Response; Analysis; Design Considerations  
Secondary Keywords: Travelling Wave Tube  
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4685  
(POWER CONDITIONING)  
(Saturable Reactors)

A PULSE COMPRESSION NETWORK  
D. Zucker  
Lawrence Livermore Lab, Livermore, CA 94550  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIIB-8 (11/1976).  
Classic pulse compression networks are typically of the Melville line type. These types of compression networks are characterized by resonant transfer of energy between identical capacitors through successively smaller inductors. These stages are isolated by switches which in the case of the Melville line are integrated into the inductor by the use of saturable magnetic cores. The reduced inductance reduces the ringing frequency and the impedance. In this paper we discuss a novel compression circuit which utilizes both saturable capacitors and saturable inductors with the resulting improvement in both compression per stage and impedance control. Some basic calculations and practical limitations of the compressor will be discussed. 0 Refs.  
Primary Keywords: Pulse Compression Technique; Saturable Inductor  
Secondary Keywords: Abstract Only  
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4686  
(ENERGY STORAGE, CAPACITIVE; PULSE GENERATORS)  
(Systems; LC)

3 MA, 600 KV FAST CAPACITOR BANK FOR A SHOCK-HEATED TORUS  
D. Markins (1), Y.G. Chen (2), C. Chin-Fatt (2) and A. DeSilva (2)  
(1) Maxwell Labs Inc, San Diego, CA 92123  
(2) University of Maryland, College Park, MD 20742  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIC-3 (11/1976).  
A high-beta, toroidal discharge is shock-heated by a hexagonal array of low-inductance, synchronized pulser modules. The toroidal load is immersed in a water-filled tank to grade the high electrical stresses. Strip-line connections between the pulser outputs and segments of the toroidal coil are made through diaphragms installed in the abutting faces of the pulser tanks and flexible seals in the load vessel. 100 kJ, LC generators in each of the oil-immersed pulser module tanks produce a peak open circuit voltage of 580 kV. Complete voltage erection occurs in a time of 14 microseconds; at this time, parallel output switches connect each erected LC generator to a toroid segment via parallel plate strip lines and an interface diaphragm. A total peak current of 3 MA with di/dt approximately 6E12 A/sec is delivered to the toroidal load coil from the six pulser modules. At current peak, parallel crowbar switches are closed in each pulser to produce an e-fold load current decay time of about 20 microseconds. Synchronous command triggering of both start and crowbar switches is achieved by three master trigger generators, each delivering 5 kV high level trigger pulses. 3 Refs.  
Primary Keywords: LC Inversion Pulse Generator Module; Triggering Considerations; Series Switching  
Secondary Keywords: Shock-heated Torus  
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4687  
(POWER CONDITIONING)  
(Pulse Forming Networks)

CONSTANT CURRENT PFN  
L. Masten and T.R. Burkes  
Texas Tech University, Lubbock, TX 79409  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIIB-3 (11/1976).  
This paper describes a procedure for designing current fed networks to produce constant current pulses into time varying loads. The procedure is an extension of Guillemin's method for PFN design for constant loads. Examples of the procedure and computer derived responses are given. Problems associated with the design of voltage fed networks which produce constant-current pulses into time varying loads are discussed. The primary problem is one of prescribing the appropriate initial conditions for analysis, so that a realizable network may be derived to produce the desired pulse with only an initial voltage on the energy storage capacitors. 0 Refs.  
Primary Keywords: Pulse Forming Network; Constant Current; Guillemin's Method; Analysis; Synthesis  
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4688  
(PULSE GENERATORS)  
(Systems)

DISCHARGE CIRCUITRY FOR HIGH REPETITION RATE METAL VAPOR LASERS  
L.W. Springer, T.W. Karres, R.S. Anderson and B.C. Bricks  
General Electric Co, King of Prussia, PA  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIIC-1 (11/1976).  
The evolution of discharge circuitry for high repetition rate metal vapor lasers is described. The circuitry needed for operation of a discharge-heated copper vapor laser at up to 12 watts average or 6 kHz rates is given. Switch characteristics and component parameters are also discussed. 5 Refs.  
Primary Keywords: Pulsed; Solid-state Trigger; Thyatron  
Secondary Keywords: Copper Vapor Laser Pumping  
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4689  
(SWITCHES, CLOSING)  
(Gas Gaps, E-beam)

ELECTRON BEAM CONTROLLED SWITCHING  
R.D. Hunter  
Maxwell Labs Inc, San Diego, CA 92123  
1976 IEEE Pulsed Power Conference Proceedings, Paper IC-8 (11/1976).  
A fast switching technique has been demonstrated which relies on the control of the impedance level of a gas discharge by an electron beam. Uncommutated di/dt's in excess of 1E11 Amperes/second were obtained for a 50 kV blocking voltage switch with a forward drop of approximately 1 kV utilizing atmospheric pressure gas in a 10 liter volume as the working medium. The scaling of recombination and attachment controlled switches is discussed in terms of molecular and discharge parameters. It is shown that gases with high drift velocities at low electrical fields are desirable for high efficiency in the switching process. Such switches appear to be scalable to the megajoule level and perhaps to recovery times on the order of 1E-8 seconds. 9 Refs.  
Primary Keywords: E-beam Controlled Switch; Fast Turn-on; Fast Recovery; Design Considerations; Performance Test  
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4690  
(SWITCHES, CLOSING; SWITCHES, CLOSING)  
(Gas Gaps, Electrical; Reviews)

GASEOUS SWITCHES: THE PAST AND PRESENT STATE OF THE ART  
H. Menoun  
English Electric Valve Co Ltd, Chelmsford, Essex, UK  
1976 IEEE Pulsed Power Conference Proceedings, Paper IA-2 (11/1976).  
Triggered discharge devices which use a gaseous medium to carry the current are discussed in a general manner. Devices operating at pressures above and below atmospheric and in vapours as well as true gases are considered. Normal and quenched spark gaps are described, along with mercury pool and hot cathode devices. A number of cold cathode switches are also briefly mentioned, including flashlamps and trigger tubes. Most emphasis is given to hydrogen thyatrons and ignitrons as these are felt to be of the greatest value in pulsed power generation. Crowbars are discussed as well as modulator applications. In each case the uses of the various devices are indicated along with the advantages and shortcomings where relevant. 0 Refs.  
Primary Keywords: Gas Gap; State-of-the-art; Quenched Spark Gap; Thyatron; Ignitron; Crowbar  
Secondary Keywords: Modulators; Applications  
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4691  
(ENERGY STORAGE, MECHANICAL)  
(Rotating Machines)  
INERTIAL ENERGY STORAGE RESEARCH AT THE UNIVERSITY OF TEXAS AT AUSTIN  
F. M. Tolk, M. D. Drago, E. R. Barker, W. F. Weldon, W. L. Bird, H. G. Rylander, and R. H. Woodson  
University of Texas at Austin, Austin, TX 78712  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIB 4 (11/1976)  
During the past few years the Energy Storage Group at the University of Texas has been doing research on the design, theory, and application of homopolar machines. Two machines have been built and a third machine is now under construction. This third machine is intended to study the fundamental limitations on fast discharging homopolar machines. Studies have been conducted on other homopolar systems with energy storage of up to 63 J. Experimental research areas discussed include brush testing, electromagnetic bearings, and cooling. Theoretical areas include pulse compression and magnetic field mapping. Other applications of homopolar machines including gunnery, military, and industrial uses have been investigated and are discussed. Funding for this program has been provided by the Texas Atomic Energy Research Foundation, the Energy Research and Development Administration and the Electric Power Research Institute.  
12 Refs.  
Primary Keywords: Inertial Energy Storage; Review; Very High Energy; Component Testing; Application  
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4692  
(PULSE GENERATORS)  
(Time Delay)  
INVERSE VOLTAGE CONTROL IN LINE TYPE PULSE GENERATING CIRCUITS  
G. Scelous and B. P. Newton  
English Electric Valve Co Ltd, Chalmersford, Essex, UK  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIC 7 (11/1976)  
Initially, various circuits are described which have been used in line type modulators either to afford rapid inverse voltage removal or protection against cumulative voltage build up following a load failure. The advantages and disadvantages of each are discussed briefly. In addition, two new circuits are described. The first combines a rapid removal of inverse voltage with precise deformation of the voltage zero immediately prior to the recharging of the tube. Although requiring extra components, this new arrangement offers advantages over circuits hitherto employed. The second new circuit is a diode switched charge sharing capacitor circuit designed to remove or reduce in amplitude the short duration inverse spikes which can occur in line type modulators. Should a thyatron be employed as the switching means, this inverse spike can lead to undesirable heating of the grid due to plasma clean up. The circuit described largely eliminates this heating and the two circuits are complementary and may be used together. 6 Refs.  
Primary Keywords: Inverse Voltage; Load Failure; Voltage Zero  
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4693  
(REVIEWS AND CONFERENCES)  
(Reviews)  
LIGHTWEIGHT MULTIGIGAWATT POWER TECHNOLOGY A SURVEY  
R. L. Verma (1), J. P. Hackl (2) and L. J. Amstutz (3)  
(1) USAF Aero Propulsion Lab  
(2) Naval Surface Weapons Center  
(3) US Army Mobility Equipment Research and Development Command  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIB 8 (11/1976)  
A discussion is presented of the various power source and conditioning technologies and hardware suitable for lightweight multigigawatt applications. Tradeoffs are shown on the basis of critical operating parameters among various power system components. Included are the applicable power sources, machines (chemically fueled and air-breathing), flywheels, rotating generators (conventional and superconducting), electrochemical devices (batteries and fuel cells) and magnetohydrodynamic generators. Also discussed is the appropriate power conditioning, energy storage (capacitive, inductive), switching (closing, opening) and power conversion (transformers, inverters). An assessment of the current state of the art in each of these technologies is given. Anticipated advancements are discussed and projections are given of potential lightweight low volume electrical power generation and conditioning capabilities through the 1990-2010 time period. 9 Refs.  
Primary Keywords: High Power Technology; Operating Parameters; Fuel; Energy Storage; Magnetohydrodynamic  
Secondary Keywords: Abstract  
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4694  
(POWER CONDITIONING)  
(Current Limiters)  
LIQUID NITROGEN COATED WIRE AS SWITCHABLE HIGH POWER DIRECT CURRENT LIMITING ELEMENTS  
A. S. Gilmore and J. D. Marshall  
State University of New York at Buffalo, Buffalo, NY 14226  
1976 IEEE Pulsed Power Conference Proceedings, Paper IC 5 (11/1976)  
While designing a high power current limiting device which utilizes the large change of resistivity with temperature of certain metals, it was discovered that some metals, when immersed in liquid nitrogen may form a jacket of gaseous nitrogen around them and can be heated electrically to any temperature up to their melting point without oxidation. Due to this effect, herein called the vapor lock effect, the resistivity of the metal has been observed to increase by a factor of 91 and power dissipation of up to 500 W/cm<sup>2</sup> can be achieved. By using these properties along with a wire suspended switching arrangement for several metal elements may aid in the development of reliable and compact high power current limiting devices. 3 Refs.  
Primary Keywords: Current Limiters; Nonlinear Resistor; Liquid Nitrogen; Cooling; Vapor Lock Effect  
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4695  
(PARTICLE BEAMS, ELECTRON)  
(Transverse)  
METAL FOILS FOR USE IN PULSED LASER APPLICATIONS  
C. G. Hoffman  
Los Alamos National Lab, Los Alamos, NM 87555  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIC 2 (11/1976)  
Testing of foils used for electron gun windows for laser pumping is the subject of this paper. Several foils of different composition are tested and results are presented concerning the number and size of perforations, grain size, and second and third phases. The effects of heating are considered, as are the effects of electron irradiation. 9 Refs.  
Primary Keywords: Metal Foil Windows; Electron Windows; Specifications; Test Results  
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4696  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
MICROWAVE EMISSION FROM MAGNETICALLY INSULATED RELATIVISTIC ELECTRON BEAM DIODES  
G. Bekefi and J. J. Orszagowski  
Massachusetts Institute of Technology, Cambridge, MA  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIC 3 (11/1976)  
Experiments will be described concerning the behavior of cylindrical field emission diodes immersed in externally applied magnetic fields < 20 kG. Sizeable current flows are observed even in forbidden regions of magnetic field in which the diode is presumably insulated magnetically. This current flow is accompanied by intense microwave radiation. In the case of smooth anodes, the emission is fairly broadband in frequency, and does not exceed several kilowatts in power. When the anode supports a periodic structure, narrow band emission in the gigahertz range of powers is observed. In the latter case, approximately 35% of the beam kinetic energy is converted into radiation. 24 Refs.  
Primary Keywords: Microwave Emission; Field Emission Diode; Magnetic Insulation; Smooth Anode; Periodic Structure  
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4697  
(PULSE CONDITIONING)  
(Pulse Forming Networks)  
NETWORKS FOR DRIVING TEA LASERS  
A. Roshell  
Texas Tech University, Lubbock, TX 79409  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIB 4 (11/1976)  
A new type of pulse forming network is described. The PFN produces a train of pulses for simultaneously driving a CO<sub>2</sub> sub 22 TEA laser and sustaining the discharge in the TEA laser without arc formation. The PFN offers the advantage of not requiring active circuitry, such as hard tube modulators. 3 Refs.  
Primary Keywords: Pulse forming network; Burst Mode; Pulse Train  
Secondary Keywords: Gas Laser Pumping  
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4698  
(ENERGY STORAGE, MECHANICAL)  
(Rotating Machines)  
ONE MILLISECOND DISCHARGE TIME HOMOPOLAR MACHINE  
J. E. Gully, M. D. Drago, B. Grant, H. G. Rylander, F. M. Tolk, W. F. Weldon, and R. H. Woodson  
University of Texas at Austin, Austin, TX 78712  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIR 2 (11/1976)  
All information now available concerning fast discharge homopolar machines is only theoretical. No such machine has ever been built and existing electrical machines do not approach the extremely severe conditions required for a fast discharge machine. The Energy Storage Group at the University of Texas at Austin has designed and is in an advanced stage of building a very fast discharge experimental homopolar machine which will explore fundamental mechanical and electromagnetic limitations to discharge times. The IDE is a fully commutated, pulsed field homopolar generator with two commutating rotors. It will discharge in 1.01 milliseconds when short circuited. The applied field averages 4 Tesla and the equivalent capacitance is 36 mF. When discharged from full speed into a load having 0.275 microhenry inductance and 60 microhm resistance, the discharge time will increase to 3.075 milliseconds and the efficiency of the discharge will approach 80 percent. This research has been funded by the Electric Power Research Institute, Texas Atomic Energy Research Foundation and the US Energy Research and Development Administration. 2 Refs.  
Primary Keywords: Homopolar Generator; Fast Discharge; Pulsed Field; High Efficiency  
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4699  
(PULSE CONDITIONING)  
(Pulse Forming Networks)  
PFN DESIGN INTERFACE WITH 1.8 μm SUSTAINED GAS DISCHARGE  
J. P. Gifford  
AEG, Kirtland AFB, NM 87117  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIC 5 (11/1976)  
The one known time varying conductivity characteristics of electron beam sustained gas discharges require special consideration in the design interface with the pulse forming network in line type modulators. Equations and tables are used to analyze effects of varying E, B, a non uniform electron beam, and the interaction with the PFN. Experimental data is compared to calculations and found to be in reasonable agreement. 2 Refs.  
Primary Keywords: CO<sub>2</sub> Laser; Interface; Time Varying Impedance; Line Type Modulator; Computer Calculation  
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4700  
(EXPERIMENTAL STUDIES)  
(Gases, Optical)  
DEVELOPMENT AND PERFORMANCE CHARACTERISTICS OF A UV PREIONIZED, HIGH POWER TEA PULSED CO<sub>2</sub> LASER  
T. Ohmura and T. Sakaguchi  
University of Tokyo, Hongo, Bunkyo, Tokyo  
Japanese Journal of Applied Physics, Vol. 19, No. 8, pp 1493-1504 (1980)  
A high power TEA CO<sub>2</sub> sub 22 laser was developed and tested. The laser used UV preionization and produced a total output energy of 300 mJ with the focus area lasting 50 ns. The preionization characteristics, the effect of the preionization on the main discharge, the effect of gas composition on the small signal gain, and laser oscillation characteristics are also discussed. 12 Refs.  
Primary Keywords: UV Preionized; Energy Deposition; Discharge Characteristics  
Secondary Keywords: Gas Laser Pumping  
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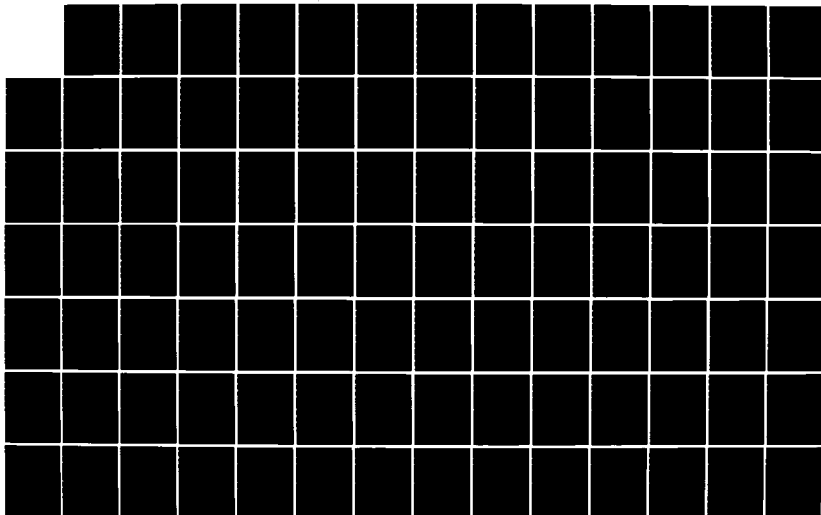
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J BEMESDERFER ET AL. AUG 83 AFWL-TR-83-74-VOL-2

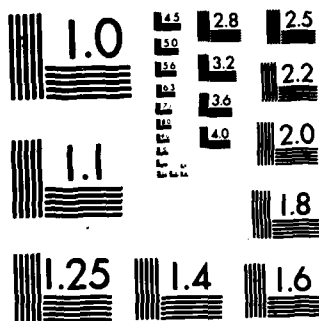
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MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS-1963-A



4781  
(ENERGY STORAGE, CAPACITIVE)  
(Systems)

PRINCIPAL CONSIDERATIONS IN LARGE ENERGY-STORAGE CAPACITOR BANKS  
E.L. Kemp  
Los Alamos National Labs, Los Alamos, NM 87545  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIC-1 (11/1976).  
Capacitor banks storing one or more megajoules and costing more than one million dollars have unique problems not often found in smaller systems. Two large banks, Scyllac at Los Alamos and Shiva at Livermore, are used as models of large, complex systems. Scyllac is a 10-MJ, 60-kV theta pinch system while Shiva is a 20-MJ, 20-kV energy system for laser flash lamps. A number of design principles are emphasized for expediting the design and construction of large banks. The sensitive features of the charge system, the storage system layout, the switching system, the transmission system, and the design of the principal bank components are presented. Project management and planning must involve a PERT chart with certain common features for all the activities. The importance of the budget is emphasized. 3 Refs.

Primary Keywords: High Energy Capacitor Bank; Scyllac Bank; Shiva Bank; Design Considerations; Construction Schedule  
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4782  
(ENERGY STORAGE, CAPACITIVE; PARTICLE BEAMS, ELECTRON; SYSTEMS)  
(Mark Generators; Generation)

PULSED POWER SYSTEMS FOR THE LASL HIGH ENERGY GAS LASER FACILITY  
K. Riepe and H. Jansen  
Los Alamos National Labs, Los Alamos, NM 87545  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIC-5 (11/1976).  
The laser division at Los Alamos Scientific Laboratory is designing a CO/sub 2/ laser fusion experiment with the goal of delivering 100 kJ to the target in a one nanosecond pulse. The laser will be pumped by an electron-beam-controlled discharge. The pumping power supply will be a number of parallel Marx generators, with an output voltage of 500 kV, and a total energy storage of about 5 MJ. The electron gun is a cold cathode triode, also operating at about 500 kV. Preliminary design considerations for the pulsed power systems are presented. Some pulse forming network designs are discussed with calculated waveforms shown. 1 Refs.  
Primary Keywords: Marx Generator; Cold Cathode Triode; Reliability  
Secondary Keywords: Gas Laser Pumping  
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4784  
(SYSTEMS)  
( )

PULSE POWER REQUIREMENTS FOR LASER ISOTOPE SEPARATION SYSTEMS  
P. Mace, E.A. O'Neil and M. Piltch  
Los Alamos National Labs, Los Alamos, NM 87545  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIIC-3 (11/1976).  
The uranium enrichment process currently under investigation at the Los Alamos Scientific Laboratory will require pulsed lasers with unique characteristics. The requirements are such that great demands will be made on the state-of-the-art in terms of pulsed power components and techniques. This paper is devoted to a discussion of the pulsed laser output characteristics and their relationship to available electrical devices. Further research areas will be designated as they are seen to affect the system requirements. 8 Refs.  
Primary Keywords: Laser Isotope Separation; Rep-rated; Switching Requirements  
Secondary Keywords: IR Laser; UV Laser  
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4786  
(SWITCHES, CLOSING; SWITCHES, OPENING)  
(Vacuum Tubes; Vacuum Tubes)  
RECENT DEVELOPMENTS IN HIGH POWER SWITCH TUBES FOR HIGH POWER RADAR AND FUSION RESEARCH

Mark, J.T. and J.A. Eshleman  
RCA Corp, Lancaster, PA 17104  
1976 IEEE Pulsed Power Conference Proceedings, Paper IC-5 (11/1976).  
This paper describes two tubes now in development. The first is a 425 kV, 20 kA switch tube with a long life, tungsten matrix cathode and conduction cooled, copper alloy grids. The second is a 24 megawatt, 200 kV switch tube with thoriated tungsten cathodes and water cooled electrodes. 1 Refs.  
Primary Keywords: RCA A2960B Switch Tube; Tungsten Matrix Cathode; Copper Alloy Grid; Thoriated Tungsten Cathode; Long Life  
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4787  
(SWITCHES, CLOSING)  
(Thyristors)

SOLID STATE HIGH POWER PULSE SWITCHING  
P.F. Pittman and D.J. Page  
Westinghouse Electric Corp, Pittsburgh PA  
1976 IEEE Pulsed Power Conference Proceedings, Paper IA-3 (11/1976).  
In this paper, the structural features and the methods of turning on high power thyristors, reverse blocking diode thyristors and light activated silicon switches are reviewed. The advantages and limitations of these devices are described together with a description of the performance achieved to date by the various devices. Finally, the operation of these devices in series strings to form high power switching modules is described. 2 Refs.  
Primary Keywords: High Power Thyristor; Reverse Blocking Diode Thyristor; Light Activated Silicon Switch; Performance; Series String  
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4788  
(SWITCHES, CLOSING)  
(Liquid Metal)

THE LIQUID METAL PLASMA VALVE CLOSING SWITCH  
J.R. Bayless (1) and J.P. McKel (2)  
(1) Hughes Research Labs, Malibu, CA 90265  
(2) Naval Surface Weapons Center, Silver Spring, MD 20910  
1976 IEEE Pulsed Power Conference Proceedings, Paper IB-3 (11/1976).  
The liquid metal plasma valve is a high average power mercury vacuum-arc switching device. It has been extensively developed over the past ten years as a converter valve for the use by the electric utilities industry at nominal average power levels of 90 MW. This paper will describe an LMPV closing switch now under development for operation in conjunction with a PFN to deliver 1 MW average power to a load in 20 to 50 microsecond pulses at up to 100 kV. The objective of this development is to obtain information for the design of switches capable of operating at such higher power levels. 1 Refs.  
Primary Keywords: Liquid Metal Plasma Valve; High Average Power; Vacuum Arc; Ignitor  
Secondary Keywords: Pulse Forming Network  
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4789  
(SWITCHES, OPENING)  
(Vacuum Gaps, Plasma Erosion)

THE PLASMA EROSION SWITCH  
C.M. Mendel, S.A. Goldstein and P.A. Miller  
Sandia Labs, Albuquerque, NM 87115  
1976 IEEE Pulsed Power Conference Proceedings, Paper IC-2 (11/1976).  
The plasma erosion switch is a device capable of initially carrying high currents, and then of opening in nanoseconds to stand off high voltages. It depends upon the erosion of a plasma which initially fills the switch. The sheath between the plasma and the cathode behaves as a diode with a rapidly increasing A-K gap. Preliminary tests of the switch on the Proto I accelerator at Sandia will be described. In these tests, the switch consisted of a cylinder of highly ionized plasma four inches in diameter and one-inch thick surrounding a one-inch cathode. The switch shorted out prepulse voltages and allowed energy to be stored in the diode inductance outside the switch until the accelerator current reached 75 kA. The switch impedance then rose rapidly to approximately 100 ohms in 5 nanoseconds, whereupon the accelerator current transferred to the cathode. Current rise rates of 1E15 A/sec were limited by cathode turn-on. Voltage rise rates of 1E15 V/sec were achieved. The elimination of prepulse and machine turn-on transients allowed A-K gaps of 2 mm to be used with 2.5 MV pulses, yielding average E fields of 12 MV/cm. 8 Refs.  
Primary Keywords: Plasma Erosion Switch; Diode; Fast Opening Time; Plasma Depletion  
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4710  
(SWITCHES, OPENING)  
(Vacuum Gaps, Magnetic Field)  
THE PRESENT STATUS AND PROJECTED CAPABILITIES OF VACUUM ARC OPENING SWITCHES

A.S. Gilmour  
State University of New York at Buffalo, Buffalo, NY 14226  
1976 IEEE Pulsed Power Conference Proceedings, Paper IC-1 (11/1976).  
Vacuum arc opening switches are under development at the State University of New York at Buffalo. The configuration of these devices is such that electron current is forced to flow, primarily, radially outward from the end of a relatively small rod shaped cathode to a ring shaped anode. The source of current is a vacuum arc that is initiated on the surface of the cathode by a pulse to an igniter electrode. This vacuum arc also generates a metallic plasma in the cathode to anode region resulting in a low switch drop during conduction. Current control is achieved through the application of an axial magnetic field. Operating characteristics that have been achieved are circuit interruption at DC voltages up to 25 kV, control of currents up to 10 kA and operation at repetition frequencies up to 1 kHz. The turn-on and turn-off times are, respectively, as short as one and two microseconds. The pulse width is continuously variable. Applications being considered at the present time include high-power inverters, fault-current limiters and high-power modulators. The status of the device development is described and then projected capabilities are given. 10 Refs.  
Primary Keywords: Vacuum Arc Opening Switch; Low Dissipation; Magnetic Field Interruption Mechanism  
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4711  
(ENERGY CONVERSION, ELECTRICAL)  
(Charging Circuits)  
TIME SELECTIVE RECHARGING OF AN AUXILIARY PULSER

E.H. Meopier and R.A. Gardenghi  
Westinghouse Electric Corp, Baltimore, MD 21203  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIIB-7 (11/1976).  
This paper describes a technique for maximizing the utilization of a prime power source when the principle load is a line type pulser. A resonantly charged line-type pulser draws energy from the prime source in a periodic manner resulting in dead spots or load valleys between cycles. Time limited resonant charging may be used to draw energy from the prime source during these load valleys to provide power for auxiliary equipment. This increases power available from the source without increasing peak power demand. Basic circuits and waveforms are presented. 2 Refs.  
Primary Keywords: Charging Circuit; Line Type Pulser; Maximum Utilization Of Prime Power Source  
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4712  
(ENERGY STORAGE, MECHANICAL)  
(Rotating Machines)  
U.S. AIR FORCE SUPERCONDUCTING GENERATOR DEVELOPMENT

M.L. Southall  
AFAPL, Wright-Patterson AFB, OH  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIB-8 (11/1976).  
A review of Air Force-sponsored development of a 12,000 RPM superconducting generator is presented. Results are given for recent critical component tests including stator coils and four coil rotor assembly. A brief discussion of potential future work in high power superconducting generators is given. Superconducting generators with specific weights of less than 0.1 lb/kva in the multimegawatt class can be anticipated. 7 Refs.  
Primary Keywords: Superconducting Generator; Lightweight Generator; Airborne Power Supply  
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4713  
(POWER CONDITIONING)  
(Pulse Transformers)  
AN ANALYSIS OF POWER TRANSFORMERS UNDER TRANSIENT CONDITIONS  
D.L. Lockwood, R.I. McNeil Jr. and R.F. Whitbeck  
Thermal Technology Lab, Inc., Buffalo, NY  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIE-1 (11/1976).  
Low specific weight transformers may be designed to operate under impulse conditions well above the steady state limit. This usually results in nonlinear current and voltage transformation. A procedure is outlined in this paper for the analysis of lumped parameter transformer models with nonlinear self-inductance. An algorithm for modeling inductance is developed which is accurate for square loop cores as well as ordinary soft magnetic materials. A simple routine which can be implemented with modest computing power is used to determine the dynamic response of transformers driven by a variety of sources. The model permits independent assignment of initial conditions for the magnetic state of the core and the phase of the driving source. This permits a computation of inrush currents and output waveforms under the entire range of possible initial conditions. This work was sponsored by the United States Air Force Aero Propulsion Laboratory, Wright Patterson Air Force Base, Ohio. 2 Refs.  
Primary Keywords: Lightweight Power Transformer; Pulse Application; Modeling  
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4714  
(PULSE GENERATORS)  
(Trigger)  
AN AIR-POWERED FIBER-OPTIC COUPLED PULSER SYSTEM FOR CTR EXPERIMENTS  
M.C. Munnally and A.T. Brousseau  
Los Alamos National Labs, Los Alamos, NM 87545  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIID-6 (11/1976).  
The design, construction, and operation of an air-powered fiber-optic coupled pulser system for initiating various high-voltage systems in Controlled Thermonuclear Research Experiments are discussed. The pulser system provides complete electrical isolation of the experimental high-voltage circuits from the timing and control circuits. It also prevents crosstalk between individual pulser output channels and eliminates trigger system ground loops. The electronic design and reliability of the pulser system, including the fiber-optic electrical interface considerations, are discussed. A description of the air-driven power supply and a brief cost analysis of this system compared to conventional pulser systems are presented. 8 Refs.  
Primary Keywords: Pulser; Fiber Optic Coupling; Electrical Isolation; Air-driven Power Supply  
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4715  
(POWER CONDITIONING)  
(Pulse Transformers)  
AN ANALYSIS OF CO-AXIAL PULSE TRANSFORMERS  
R. Dollinger and D.L. Smith  
Texas Tech University, Lubbock, TX 79409  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIE-4 (11/1976).  
The basic idea of using a co-axial cable as an isolation pulse transformer for triggering spark gaps is not new. However, there are several distinct advantages of driving the braid as the primary as opposed to driving the inner conductor. The fundamental advantage is that the ratio of the output voltage to the input voltage is unaffected by the thickness of insulation between the inner conductor(s) and the braid. Thus, the transformer with the braid as the primary works well for isolating high secondary to primary voltages. This and other advantages are demonstrated. 6 Refs.  
Primary Keywords: Co-axial Pulse Transformer; Outer Conductor Primary; Strong Coupling; High Voltage  
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4716  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
AN INEXPENSIVE HIGH VOLTAGE PROBE  
R. Dollinger and D.L. Smith  
Texas Tech University, Lubbock, TX 79409  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIE-8 (11/1976).  
A simple, easily constructed, high voltage probe (< 500 kV) with a good frequency response (< 100 MHz) and high input impedance (> 10 kOhm) is desirable in many applications. Such a probe, constructed of two concentric cylinders of Velostat is reported. 2 Refs.  
Primary Keywords: High Voltage Probe; Simple Design; Simple Construction; High Frequency Response  
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4717  
(ENERGY CONVERSION, THERMAL)  
(Loads)  
A COMPACT LOW INDUCTANCE LOAD FOR PULSE TESTS  
R.D. Gourlay  
Hughes Aircraft Co, Culver City, CA 90230  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIE-6 (11/1976).  
The development of a low inductance resistive load for high energy pulse tests is described. The performance requirements and design alternatives for a specific application are discussed. The selected design is an air cooled bank of silicon carbide resistors in parallel coaxial mounts. This design has an inductance less than 25nH, a continuous power dissipation exceeding 50kW and a peak pulse voltage rating of 22kV. The load will operate 40kV off ground. The grounded enclosure is a 3-foot cube that permits stacking for higher power requirements. 3 Refs.  
Primary Keywords: Resistive Load; Low Inductance; High Power; Medium Voltage  
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4718  
(ENERGY STORAGE, CAPACITIVE; PULSE GENERATORS)  
(Systems; Systems)  
A HIGH CURRENT, HIGH FREQUENCY CAPACITIVE ENERGY STORAGE SYSTEM USED TO PRODUCE INTENSE MAGNETIC FIELDS  
D. Markins, J. Bandas and M.T. Olson  
Maxwell Labs Inc, San Diego, CA 92123  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIID-2 (11/1976).  
Recent component design and fabrication concepts have evolved a versatile high current, low inductance capacitive energy storage system in which a modular approach allows for expansion to larger systems. The design utilizes low inductance, high voltage reversal capacitors with a low profile bushing. The capacitors are connected in parallel in a mylar insulated parallel plate transmission line. An important feature of the design is the gas, multichannel, rail spark gap switching system which provides low inductance combined with high current, high Coulomb capabilities. A system incorporating these design features is currently in operation to produce intense pulsed magnetic fields. The machine is a 50 kV, 60 kJ, 9 nH design which is capable of currents in excess of 1 MA and di/dt's of 5E12 amp/sec. In the present application, the load is a single turn inductor and the peak current is 1.2 MA. Pulsed magnetic fields of 500,000 Gauss have been produced at frequencies of 160 kHz. Fields of these frequencies and intensities are being used to impact-bond metals, illustrating one of many potential applications of such a system. 1 Refs.  
Primary Keywords: Capacitor Bank; High Current; Low Impedance; Rail Gap; Pulsed Magnetic Field  
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4719  
(PULSE GENERATORS; ENERGY STORAGE, CAPACITIVE)  
(Systems; Systems)  
A MODULAR POWER-CROWBAR BANK FOR THE GENERATION OF A 50 MA, 50 MICROSECOND CURRENT PULSE FOR THE TOROIDAL PLASMA EXPERIMENT NBS II AT GARCHING  
E. Breit, J.E. Gruber, M. Munich, G. Schramm, U. Seidel and R. Sub  
Max-Planck-Institut für Plasmaphysik, Garching, Euratom Assoc.  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIIE-7 (11/1976).  
The 50 A long, single-turn stellerator coil for the toroidal NBS II experiment at Garching will be fed from a low inductance modular power-crowbar bank. A start bank 2 x 40 kV, 768 kJ consisting of 96 modules generates a submicrosecond current rise while the power-crowbar bank 3 kV, 3.3 MJ extends the pulse for 50 microseconds. The slide-in modules with newly developed capacitors and double-gap switches are described as well as the channel diagnostics by means of fibre-optics. 1 Refs.  
Primary Keywords: Capacitor Bank; High Energy; Low Voltage; Low Inductance; Modular Construction; Double-gap Spark Gap  
Secondary Keywords: Stellerator  
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4721  
(ENERGY STORAGE, INDUCTIVE)  
(Reviews)  
DEVELOPMENT OF INDUCTIVE STORAGE FOR GENERATION OF HIGH VOLTAGE PULSES  
I.M. Vitkovitsky  
Naval Research Lab, Washington, DC 20375  
1976 IEEE Pulsed Power Conference Proceedings, Paper IID-2 (11/1976).  
Traditionally, the generation of very high power electromagnetic pulses, applied to the production of intense relativistic beams, dense hot plasmas and other transient phenomena has depended on the capacitive energy storage. Growing needs for increased energy capability of the generators has led to studies and proposals to demonstrate the feasibility of using magnetic storage systems with high voltage, power-multiplying stages as a means of satisfying these needs. Most recent progress in the development of the elements for such high power systems is presented. Examples demonstrating the integration of inductive storage and high voltage technologies, to achieve high power output are considered. 12 Refs.  
Primary Keywords: Inductive Energy Storage; Basic Concepts; Circuit  
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4722  
(PULSE GENERATORS)  
(Systems)  
HIGH-VOLTAGE PULSE GENERATORS OF THE BASE OF THE SHOCK TRANSFORMER  
E.A. Abramyan  
Academy of Sciences of the USSR, Moscow, USSR  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIE-3 (11/1976).  
A review of the accelerators comprising a resonance transformer with shock excitation as a power supply source is given. Operating voltage is approximately 1 MV, pulse length 1E-7 - 1E5 sec, repetition rate - up to 100 Hz and above. 12 Refs.  
Primary Keywords: Pulse Generator; Shock Transformer; Rep-rated  
Secondary Keywords: E-beam Generation  
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4723  
(SWITCHES, CLOSING)  
(Vacuum Gaps, RF)  
CONTROLLED DISCHARGE IN A VACUUM GAP SWITCHED BY 1 MC CURRENT PULSES OF UP TO 150 KA  
P.M. Dashuk, G.S. Kichayev and M.D. Yarysheva  
Soviet Physics Journal, Vol. 11, No. 1, pp 1-7 (01/1968).  
Trans. From: Izvestiya Vysshikh Uchebnykh Zavedenii, Fizika 11, 11-16 (1968).  
The firing delay time, the rise time of the current up to its maximum, and the primary current amplitude of a controlled discharge in a vacuum gap are considered, for a voltage range of 10-80 kV, with a residual pressure in the chamber of 1E-4 - 1E-5 mm of mercury. The gap is switched by a damped oscillatory current pulse with a frequency of 1.25 MHz and a maximum amplitude of about 150 kA. The discharge is started by either one or three triggering devices. 5 Refs.  
Primary Keywords: 1.25 MHz Current Pulse Frequency; 10-80 kV Voltage Range; Damped Oscillatory Current Pulse; 150 kA Maximum Amplitude; Controlled Discharges  
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4724  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
1111, A 0.5-1.5 MICROSECOND, 600 KV ELECTRON BEAM ACCELERATOR  
R.S. Clark and K.R. Prestwich  
Sandia Labs, Albuquerque, NM 87115  
1976 IEEE Pulsed Power Conference Proceedings, Paper IE-1 (11/1976).  
A 600 kV, 5-14 kJ, 0.5-1.5 microsecond electron beam accelerator has been developed for gas laser excitation studies. The 1.2 MV Marx generator charges a 2 nF, solid dielectric peaking capacitor to 2.3 MV in 0.6 microsecond. The pulse duration is controlled by a crowbar switch. Cathode geometries were varied to generate a uniform current density beam and maximize the beam energy density that could be passed through thin foils. A 7.6 cm diameter cylindrical beam is guided through the laser chamber by a 1-3 kG axial magnetic field. The design and development of the accelerator, including experimental results of diode studies, are discussed. 15 Refs.  
Primary Keywords: E-beam; Field Emission Vacuum Diode; Marx Generator; Low Inductance  
Secondary Keywords: Gas Laser  
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4725  
(PARTICLE BEAMS, ELECTRON; PULSE GENERATORS)  
(Generation; Blumlein Lines)  
MODULATOR-REPEITIVE PULSED FIELD EMISSION ELECTRON BEAM GUN INTERFACE  
G.J. Dezenberg (1), M. Wright (2) and S. Schneider (2)  
(1) Army Missile Command, Redstone Arsenal, AL 35809  
(2) ECOM, Fort Monmouth, NJ 07703  
1976 IEEE Pulsed Power Conference Proceedings, Paper ID-2 (11/1976).  
A field emission electron beam gun is repetitively pulsed with a modulator in a Blumlein arrangement. The modulator is operated in an unmatched condition with the output connected directly to the gun. The gun is a time varying monotonically decreasing impedance load while the modulator impedance is constant. The modulator-gun configuration produces an initial voltage peak which approaches twice the value of the charge voltage to promote gun emission. After the initial peak the load voltage plateaus at a value determined by the gun impedance. Peak voltages in excess of 350 kV and peak currents up to 8 kA have been delivered in 5 microsecond pulses by the modulator to the gun. The modulator routinely operates at 50 Hz repetition rate, 135 kV recharge voltage and about 3 amps of average current. 5 Refs.  
Primary Keywords: E-beam Gun; Rep-rated; Blumlein; Cold Cathode; Pulse Forming Network  
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4726  
(PULSE GENERATORS; REVIEWS AND CONFERENCES)  
(Reviews)  
NANOSECOND PULSE GENERATORS FOR MAGNETRON OPERATION  
R.E. Nyswander and G.J. Auger  
Naval Weapons Center, China Lake, CA 93555  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIID-4 (11/1976).  
To operate with pulse durations of under 15 ns, most magnetrons require a special type of modulation signal. This paper describes the design and operation of practical short pulse modulator circuits providing magnetron outputs as short as 7 ns. The resulting transmitters provide an economical approach to high resolution radar systems. The short pulse techniques have also been used to enhance the coherent operation of magnetrons which are being pumped with an RF reference signal. 1 Ref.  
Primary Keywords: Short Pulse Generator; Modulator; Pedestal Generator  
Secondary Keywords: Magnetron; Radar  
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4727  
(ENERGY STORAGE, CAPACITIVE)  
(Reviews)  
PULSED ENERGY AND SWITCHING REQUIREMENTS FOR TOKAMAK OHMIC HEATING  
M.F. Vogel (1), K.I. Thomsen (1), M. Bird (2) and F.M. Heck (3)  
(1) Los Alamos National Labs, Los Alamos, NM 87545  
(2) University of Texas at Austin, Austin, TX 78712  
(3) Westinghouse Electric Corp, Fusion Power Systems Dept.  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIIE-9 (11/1976).  
The electrical circuit requirements are presented which result from a study of the ohmic-heating system of a Tokamak Experimental Power Reactor (EPR). A computer model for plasma startup was developed as part of an electrical network analysis program. The results of a parametric study are presented in which the pulsed energy and voltsecond-requirements were optimized; electrical machinery was selected, and the switching requirements were defined. 4 Refs.  
Primary Keywords: Pulsed Power Requirements; Numerical Calculation; Modeling  
Secondary Keywords: Tokamak; Ohmic Heating  
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4728  
(PARTICLE BEAMS, ELECTRON)  
(Systems)  
REBLE, A RADIALLY CONVERGING ELECTRON BEAM ACCELERATOR  
J.J. Ramirez and K.R. Prestwich  
Sandia Labs, Albuquerque, NM 87115  
1976 IEEE Pulsed Power Conference Proceedings, Paper IE-3 (11/1976).  
The Reble accelerator at Sandia Laboratories is described. This accelerator was developed to provide an experimental source for studying the relevant diode physics, beam propagation, beam energy deposition in a gas using a radially converging e-beam. The nominal parameters for Reble are 1 MV, 200 kA, 20 ns e-beam pulse. The anode and cathode are concentric cylinders with the anode as the inner cylinder. The radial beam can be propagated through the thin foil anode into the laser gas volume. The design and performance of the various components of the accelerator are presented. 11 Refs.  
Primary Keywords: Reble; Field Emission; Vacuum Diode; Transport; Energy Deposition  
Secondary Keywords: Gas Laser  
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4729  
(PARTICLE BEAMS, ELECTRON; PARTICLE BEAMS, ELECTRON)  
(Generation; Transport)  
RECTANGULAR BEAM SCALING LAWS  
J. Shannon  
Monsieur Labs Inc, San Diego, CA 92123  
1976 IEEE Pulsed Power Conference Proceedings, Paper ID-6 (11/1976).  
Scaling laws for rectangular electron beams in the time regime < 0.1 microsecond are presented. The data covers the parameter ranges 0.5-2 MV, 1-4 cm gap spacing, up to 100 cm lengths and 7.5-30 ohms impedance. The temporal behavior of the impedance relations is also discussed. 8 Refs.  
Primary Keywords: E-beam; Rectangular Beam; Child-Langmuir Law; Variable Impedance  
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4730  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
CALIBRATION OF A KERR CELL SYSTEM FOR HIGH-VOLTAGE PULSE MEASUREMENTS  
E.C. Cassidy (1), M. N. Cones (1), DC Munsch (2) and S.R. Booker (2)  
(1) National Bureau of Standards, Washington, DC 20234  
(2) Sandia Labs, Albuquerque, NM 87115  
IEEE Transactions On Instrumentation And Measurement, Vol. IM-17, No. 4, pp 313-320 (12/1968).  
Several techniques for calibration of an electrooptical (Kerr cell) high-voltage pulse measuring system are described. Independent calibrations, without reference to pulse divider measurements, are achieved by application of a direct bias voltage to the kV demonstrator resonable agreement (to within 1 percent) between simultaneous Kerr cell and calibrated pulse divider measurements. 6 Refs.  
Primary Keywords: Kerr Cell; Calibration Technique; Several Calibration Methods; 1 Percent Measurement Accuracy  
Secondary Keywords: 1968 IEEE, Reprinted With Permission

4731  
(BREAKDOWN STUDIES)  
(Liquid, Electrical)  
SHORT PULSE ELECTRICAL BREAKDOWN STRENGTH OF H/SUB 2/ O  
J.P. VanDevender  
Sandia Labs, Albuquerque, NM 87115  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIIE-3 (11/1976).  
The electrical breakdown strength  $E_{sub} BD/$  of a water dielectric transmission line has been measured for  $7E-9 \leq t \leq 3E-8$  sec,  $4E5$  volts  $< V < 1.1E6$  volts, and  $6E7$  V/m  $< E_{sub} Bd/ < 1.1E8$  V/m. The stressed area was approximately  $8.1$  m<sup>2</sup>/sq 2", and a Weibull analysis was used to determine the area scaling. Values of  $E_{sub} Bd/$  obtained were as much as 80 percent higher than that given by extrapolation of the long pulse formulas to  $t = 2E-8$  sec. 3 Refs.  
Primary Keywords: Breakdown Strength; Medium Area; Short Pulse; Comparison To Long Pulse  
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4732  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
SPACE-CHARGE FLOW IN A NON-CYLINDRICALLY SYMMETRIC DIODE  
J.P. Quintenz and J.M. Poukey  
Sandia Labs, Albuquerque, NM 87115  
1976 IEEE Pulsed Power Conference Proceedings, Paper IE-4 (11/1976).  
The one-dimensional cylindrical space-charge limited emission and flow results of Langmuir and Biedgett are extended to the two-dimensional (r-theta) non-symmetric case by solving a fluid model numerically. It is found that particle beams thus generated can be controlled by suitable adjustment of the applied potentials and cylinder radii. A particle code has been modified to treat razor blade cathodes by including a simplified model for the blade emission. Numerical results are compared with experimental data. These results indicate that beams produced by razor blades pinch less tightly than those from block cathodes, but in some cases may still pinch enough to be interesting. 17 Refs.  
Primary Keywords: E-beam; Space Charge; Numerical Calculation; 2-d Fluid Model; Optimization  
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4733  
(PULSE GENERATORS)  
(Miscellaneous)  
THE BOUNCING CONDUCTOR GENERATOR  
E. Kunhardt, J. Tardiff and B-R Cheo  
Polytechnic Institute of New York, Farmington, NY 11755  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIID-7 (11/1976).  
A generator has been built which uses a conducting body to transfer charge between two electrodes. The generator, known as the BCG, produces baseband pulses with peak voltages of 7 kilovolts and approximately .5 nsec. rise time at a repetition rate of 70-100 pulses/sec. The peak power into a 50 ohm line is .98 MW. 2 Refs.  
Primary Keywords: Bouncing Conductor Generator; Short Rise Time; Mechanical Charge Transfer  
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4734  
(ENERGY STORAGE, INDUCTIVE)  
(Inductors)  
THE MEGAGAUSS MAGNETIC FIELD LABORATORY IN GRENOBLE  
M. Guillot (1), J. Besancon (2) and R. Signoret (3)  
(1) Lab de Magnetisme, Grenoble Cedex, France  
(2) Centre d'Etudes de Vaujours, Sevren, France  
(3) CEA Centre d'Etudes Nucleaires, Sarclay, France 92260  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIID-1 (11/1976).  
Two process of high transient magnetic field production are analyzed. With the first one, fields up to 130 T are performed by capacitor bank discharge through single turn-coil; the stability of the coil under thermal and mechanical action is discussed, tantalum appears to be the best choice as coil material. The second one is based on magnetic flux compression using explosive driven implosion of a liner. A simple cylindrical charge and its initiation generator are described. Field up to 300 T (3 MG) are obtained using moderate capacitor bank energy (43 kJ). 11 Refs.  
Primary Keywords: Very High Magnetic Fields; Capacitor Discharge; Flux Compression; Liner Implosion  
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4735  
(ENERGY CONVERSION, ELECTRICAL)  
(Power Supplies)  
WEIGHT ALGORITHMS FOR ADIABATIC TRANSFORMERS FOR PULSED HIGH POWER SYSTEMS  
R.P. McNeil (1), D.L. Lockwood (1) and A.S. Gilmour Jr. (2)  
(1) Thermal Technology Lab, Inc.  
(2) State University of New York at Buffalo, Buffalo, NY 14226  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIE-5 (11/1976).  
A transformer design computer program developed by Thermal Technology Laboratory, Inc. has been used in a mode whereby it automatically minimized the weight of a transformer with any given set of operating parameters. Four classes of adiabatic transformers (wherein heat capacity is used to absorb heat generated) for use in pulsed power systems have been investigated in detail. Two of these were at power levels in the 10 to 50 MW range and the other two were in the 1 to 5 MW range. In each power range, three-phase square wave transformers were analyzed in detail. The three phase transformers would be used in conjunction with alternators. The single phase units would be used in inverters. This paper gives a brief description of the transformer design program and then summarizes the results of weight studies on over 120 optimized transformers designed for operation at various powers, voltages, frequencies and pulse durations. Algorithms developed for calculating transformer specific weight as functions of these parameters are given. 1 Refs.  
Primary Keywords: Transformer Design; Computer Aided Design; Adiabatic; Mod.; Light Weight  
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4736  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
100 GW ELECTRON BEAM GENERATOR  
M.I. Milde (1) and M.W. Harris (2)  
(1) Ion Physics Corp, Burlington, MA 01803  
(2) Naval Res. Lab., Washington, DC 20375  
1976 IEEE Pulsed Power Conference Proceedings, Paper ID-4 (11/1976).  
A 100 GW electron beam generator consisting of an LC generator, a coaxial water line, and 8-channel output switch, and a field emission diode are described. This generator, directed toward the support of research activities, is capable of producing up to 16 kJ of beam energy with particle energies in the range of 100 to 500 keV. 5 Refs.  
Primary Keywords: E-beam Generator; LC Pulse Generator; Field-Emission Diode; Ion Beam Conversion; Modulator; High Power  
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4737  
(ENERGY STORAGE, CAPACITIVE)  
(Capacitors)  
PULSE DISCHARGE CAPACITOR WEIGHT MINIMIZATION BY PEAK FOIL EDGE FIELDS  
R.D. Parker  
Hughes Aircraft Co. Culver City, CA 90230  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIIB-2 (11/1976).  
Corona failure at foil edges is the principle failure mechanism in well designed and manufactured high energy density pulse discharge capacitors. By forming the foil edge laser cutting or spark discharge machining, a 25 percent increase in corona inception voltage over untreated edges is obtained. Foiled foil produces a larger increase. Weight minimization using peak edge field as the limiting factor suggests a configuration where the foil and dielectric are of equal thickness produces the lightest capacitor. Typical designs are presented. 4 Refs.  
Primary Keywords: Pulse Discharge Capacitor; Weight Minimization; Foil Edge Fields; Failure Modes  
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4741  
(SWITCHES, CLOSING)  
(Mechanical)  
A SIMPLE CIRCUIT FOR THE PRODUCTION OF A HIGH VOLTAGE STEP  
G. Clark and A. Roberts  
Huddersfield Polytechnic, Huddersfield  
Journal of Physics E: Scientific Instruments, Vol. 5, pp 848-849 (09/1972).  
This note describes the development of a circuit and switch capable of producing a highly stable step voltage of up to 30 kV, with a switching time of 1 ns. The design allows absorption current measurements to be made which are not possible at low voltages on certain dielectric materials. 2 Refs.  
Primary Keywords: High Voltage DC Power Supply; Mechanical Switch; Magnetically Driven Plunger (solenoid); 1 ns Rise Time; Discharge; Little Cont. Bounce  
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4743  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
A TRIGGERED SPARK GAP WITH ROTATING ELECTRODES  
M.M. Fulbright  
University of Rochester, River Campus Station, Rochester, NY 14627  
Nuclear Instruments and Methods 104, Pp 71-72 (05/1972).  
A spark gap used for triggering a spark counter is described, featuring rotating Sparkonite electrodes. It operates for more than 1E6 firings without apparent deterioration of characteristics. 0 Refs.  
Primary Keywords: Electrically Triggered Spark Gap; Rotating Electrodes; High Reliability; Low Brush Wear  
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4744  
(SWITCHES, CLOSING; INSULATION, MATERIAL; SYSTEMS)  
(Gas Gaps, Electrical; Solid)  
A VERSATILE 60 KV SWITCHING SYSTEM FOR PULSED EXCITATION OF LASERS  
L.R. Lidholt  
Research Institute of National Defense, Stockholm, Sweden  
The Review of Scientific Instruments, Vol. 43, No. 12, pp 1765-1768 (12/1972).  
A fast switching high voltage system capable of handling 60 kV is described. The system utilizes a sealed-off pressurized hydrogen spark gap as a switching device. A versatile silicone rubber coupling module makes different high voltage components easily interchangeable without the need of draining off any insulation liquid. The system was used to build a laser, which emits radiation pulses of a few nanoseconds duration at a wavelength ranging from 337 nm in the ultraviolet region of the spectrum to 9.8 microns in the infrared. The uv pulses contain enough energy to permit pumping of a tunable rhodamine & G dye laser. 20 Refs.  
Primary Keywords: Hydrogen Spark Gap; Atmosphere Pressure; Insulation Technique; Silicone Rubber Boot  
Secondary Keywords: Dye Laser; Pumping  
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4745  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
AN OPTICAL TECHNIQUE FOR HIGH VOLTAGE MEASUREMENTS  
Unknown  
Optical Spectra, Vol. 6, No. 9, pp 19-20 (09/1972).  
A method of measuring pulsed high-voltages using optical fringe patterns is presented. The fringe pattern is produced in a calibrated Kerr cell which is illuminated with an expanded-beam pulsed laser so that high-speed photographic equipment can record the optical fringe. 0 Refs.  
Primary Keywords: Kerr Effect; High Isolation; Nitrobenzene; Argon Laser; No Spa Charge  
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4749  
(SWITCHES, CLOSING)  
(Vacuum Gaps, E-beam)  
BREAKDOWN OF A VACUUM SPARK GAP TRIGGERED BY AN ELECTRON BEAM  
N.V. Belan, V.F. Gaidukov, G.I. Kostyuk, E.K. Ostrovskii and I.V. Stralkov  
Khar'kov Aeronautical Institute, USSR  
Soviet Physics-Technical Physics, Vol. 17, No. 2, pp 303-305 (08/1972).  
Trans. Zhurnal Tekhnicheskoi Fiziki 42, 382-384 (February 1972).  
Breakdown of a vacuum spark gap by an electron beam is studied. The breakdown criterion is related to the critical pressure of metal vapor in the evaporation zone at which an experimentally observable avalanche buildup of current takes place. The dependence of the discharge time lag on the electron beam parameters is examined. 4 Refs.  
Primary Keywords: Metal Evaporation; Evaporation Zone; Critical Pressure; E-beam Parameter Variation; Delay Measurement  
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4760  
(SWITCHES, CLOSING)  
(Gas Gaps, Optical)  
EFFECTS OF SPARK GAP GEOMETRY AND LASER COMPONENTS ON THE LASER-TRIGGERED ELECTRIC BREAKDOWN  
M. Pillatier  
Institut fur Plasmaphysik, Garching, FRG  
IEEE 2nd International Conference On Gas Discharge, pp 7-9 (01/1972).  
Triggering spark gaps with laser light is superior to the conventional method of electrical triggering in many fields of application. Investigations hitherto have provided only inadequate information on the influence of laser components and the spark gap geometry on the breakdown process. In order to complete the available knowledge on the subject and facilitate application of laser-triggered gaps, these parameters had to be optimized. Triggering can then be achieved with minimum laser power, thus ensuring economy of the triggering method, which is largely governed by the laser power. 11 Refs.  
Primary Keywords: Geometry Considerations; Optimization; Axial Beam Propagation; Small Gap; Effect Of Gap Medium  
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4761  
(DIAGNOSTICS AND INSTRUMENTATION; POWER TRANSMISSION)  
(E-field; Cables)  
ELECTRIC-FIELD DISTRIBUTION AROUND AN ISOLATED STRANDED CONDUCTOR  
J.G. Andrews and A.J. Shrapnel  
Central Electricity Generating Board, London, UK  
Proceedings Of The IEE, Pt. B, pp 162-166 (08/1972).  
The authors present a method for calculation of the voltage and E-fields of a stranded cable. Laplace's equation is solved analytically with the assumption that the r and theta components of the variation of potential are separable. The boundary conditions are then inserted numerically to give n equations in n unknowns. Example solutions are given, and the effect of stranding on corona is discussed. 10 Refs.  
Primary Keywords: Stranded Wire; Field Calculation; Potential Calculation; Laplace's Equation; Analytical Solution; Numerical Boundary Solution  
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4767  
(PULSE GENERATORS)  
(Blumlein Lines)  
GENERATOR WITH AMPLITUDE AND LENGTH STABILIZATION OF THE PULSE FOR SUPPLYING A STREAMER CHAMBER  
N.S. Rudenko and V.I. Tsvetkov  
Tomsk Polytechnic Institute, Tomsk, USSR  
Instruments And Experimental Techniques, Vol. 15, No. 2, pp 409-411 (04/1972).  
Trans. From: Pribyori i Tekhnika Eksperimenta 2, 94-96 (March-April 1972).  
A generator producing pulses having an amplitude of 200 kV and a length of 16 nsec is described. The pulse length of such a generator is stable and is determined by the transit time of the leading edge of the wave in the shaping line. The amplitude of the pulses is stabilized by means of a three-electrode spark gap which allows operation on the flat portion of the charging pulse of an Arkadiev-Marx generator. The results of tests performed on the generator showed that within the limits of the measurement error no scatter of the pulse amplitude or of the width of cosmic-particle tracks is observed. 5 Refs.  
Primary Keywords: Blumlein Line; Spark Gap; Stable Pulse Length; Stable Pulse Amplitude; Marx Generator  
Secondary Keywords: Streamer Chamber  
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4768  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
GROUNDED MONITOR FOR HIGH VOLTAGE ACCELERATORS  
C.G. Crockett  
Edwards High Vacuum International, Manor Royal, Crawley, Sussex, UK  
Journal of Physics E: Scientific Instruments, Vol. 5, pp 753-754 (08/1972).  
A simple apparatus is described which is used to monitor equipment in the high voltage terminal of a particle accelerator, and display the reading on a meter at ground potential. A servo mechanism is used to rotate an insulating rod coupled to a grounded potentiometer. The system, while being relatively inexpensive, provides an accuracy better than 1%. 1 Refs.  
Primary Keywords: Voltage Monitor; Servo Mechanism; Insulated Mechanical Link; Low Frequency  
Secondary Keywords: Particle Accelerator  
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4775  
(POWER CONDITIONING)  
(Pulse Forming Lines)  
HIGH-VOLTAGE GENERATOR PRODUCING SINGLE NANOSECOND PULSES ACROSS A VARIABLE LOAD

V.I. Manylov  
Academy of Sciences of the USSR, Tomsk, USSR  
Instruments And Experimental Techniques, Vol. 15, No. 2, pp 486-488  
(06/1972).  
Trans. From: Pribery i Tekhnika Eksperimenta 2, 91-93 (March-April 1972)

The construction of a generator which forms single pulses having an amplitude of 5 to 50 kV, a trailing-edge duration of 2 nsec and a length of from 3 nsec up is described. Due to the charging of the core of the shaping line the insulation conditions are considerably improved. The construction of a simple and reliable commutator with preliminary open-circuiting of the charging circuit of the shaping line is presented. 4 Refs.

Primary Keywords: Pulse Forming Line; Variable Pulse Length; Rectangular Pulse; Unmatched Load  
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4778  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
MODULATION OF THE TRANSMISSION FACTOR OF RESISTIVE DIVIDERS IN MEASURING A HIGH DC VOLTAGE

K.L. Grudev  
Institute Of Electrical Welding, Academy Of Sciences Ukrainian SSR, Kiev  
Instruments And Experimental Techniques, Vol. 15, No. 2, pp 465-467  
(06/1972).  
Trans. From: Pribery i Tekhnika Eksperimenta 2, 138-140 (March-April 1972)

A method is described for measuring high-voltage electrical signals, which is based on modulating the transmission factor of a resistive DC voltage divider. The achievable accuracy of measuring the resistance and of performing the scale conversion of the dividers according to the method proposed is in the range from 0.001 to 0.1% for resistors of approximately 0.1 to 10 Gohm which convert voltages ranging from approximately 0.05 to 1 MV. 3 Refs.

Primary Keywords: Resistive Divider; Transmission Factor Modulation; DC Voltage; 0.001 percent Accuracy  
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4780  
(PULSE GENERATORS; SWITCHES, CLOSING)  
(Systems; Gas Gaps, Electrical)  
MULTI-STAGE SYNTHETIC CIRCUIT FOR EXTRA-HIGH-VOLTAGE CIRCUIT-BREAKER TESTING

V. Zajic and G. St-Jean  
Hydro-Quebec Institute of Research, Varannes, Quebec, Canada  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-91, No. 3, pp 782-790 (06/1972).

A new synthetic testing circuit, intended mainly for E.H.V. circuit breaker tests is being described. Based on the well known idea of parallel current injection method, the circuit is created in the form of several, integrated stages. The adjustment of the circuit test voltage to the rated voltage of the tested breaker is made by connecting the stages in series, in parallel or in a series-parallel combination. This arrangement creates a special type of a combined current and voltage impulse generator. After describing the new circuit diagram and its operation, the authors give the results of the work accomplished to date. This includes an analysis of possible disturbances caused by improper triggering of the spark gaps, results of development of the spark gaps triggered, via a light beam, by plasma guns, a short description of an experimental 3 stage circuit which is now prepared for tests and an outline of the final testing circuit for voltages up to 1500 kV and equivalent 3 phase synthetic interrupting capacity of 60,000 MVA at T.R.V. frequencies as low as 600 Hz. 5 Refs.

Primary Keywords: Multistage Pulse Generator; Series-parallel Operation; Modular Construction; Trigonon Gap; Optical Trigger Isolation  
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4786  
(SWITCHES, CLOSING)  
(Vacuum Gaps, Electrical)  
RANGE OF COMMUTATABLE VOLTAGES OF VACUUM SPARK GAPS

V.K. Bacharov  
Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov, USSR  
Instruments And Experimental Techniques, Vol. 14, No. 5, pp 1418-1419  
(10/1971).  
Trans. From: Pribery i Tekhnika Eksperimenta 14, 134-135 (September-October 1971)

The minimal commutable voltages and currents of vacuum spark gaps with evaporating walls are determined as a function of the parameters of the discharge tank circuit and the inside diameter of the insulator which separates the high-voltage electrodes of the device. The results allow the working range of commutable voltages of spark gaps to be chosen, and the inside diameter of the main insulators of the spark gaps to be determined for a stipulated density and magnitude of the commutated currents; they also allow certain spark-gap insulators to be cleaned without disrupting the vacuum-tightness or cleaning the device mechanically. 6 Refs.

Primary Keywords: Vacuum Gap; Evaporating Walls; Stable Operation; Inductive Load; Capacitive Energy Store  
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4791  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
STUDIES OF SPARK FORMATION AT HIGH SWITCHING VOLTAGES OF POSITIVE POLARITY

B.E. Ganger and E.G. Meier  
Brown, Boveri & Co Ltd, Baden, Switzerland  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-91, No. 6, pp 2427-2436 (12/1972).

Studies of the development of pre-discharges with large air gaps and positive switching voltages of 1.5 and 2.0 MV are reported. Measurements of the charge flowing into the gap and recordings obtained with a high-resolution image converter have shown that the origin of the filamentary brush-like discharges moves forward at an almost constant rate of a few cm/microsecond, and that variations in luminosity are accompanied by similar fluctuations in the transfer of charge. The space behind the streamers remains without light except when a leader is formed for a short time in the event of a charge step. The discussion is illustrated by numerous photographs and oscillograms. 18 Refs.

Primary Keywords: Prebreakdown Development; Nonuniform Field Gap; Charge Transfer; Rod-plane Gap  
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4803  
(BREAKDOWN STUDIES)  
(Solid, Electrical)  
UNIT FOR INVESTIGATING THE OPTICAL AND ELECTRICAL CHARACTERISTICS OF NANOSECOND BREAKDOWN OF CONDENSED MEDIA

V.V. Lopatin and V.Ya. Ushekov  
Tomsk Polytechnic Institute, Tomsk, USSR  
Instruments And Experimental Techniques, Vol. 15, No. 1, pp 165-167  
(02/1972).  
Trans. From: Pribery i Tekhnika Eksperimenta 1, 144-146 (January-February 1972)

A unit is described containing a nanosecond generator producing pulses having an amplitude of 400 kV and a controllable length, a network for recording the pulse prebreakdown current having an amplitude  $>5$  mA, an electron-optic shutter, and a light amplifier. The length of the voltage pulse can be controlled by a controllable clipping spark gap in which a discharge in a liquid along the surface of a solid dielectric is used. The recordings of the prebreakdown current with compensation of the capacitive component is achieved using a bridge circuit based on Rogowski transformers. 9 Refs.

Primary Keywords: Insulation Breakdown; Solid Breakdown; Pulse Generator; Voltage Monitor; Current Monitor; Displacement Current Compensation; Optical Monitor  
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4805  
(POWER CONDITIONING)  
(Systems)  
POWER CONDITIONING SYSTEMS FOR HIGH-POWER, AIRBORNE, PULSED APPLICATIONS  
A.S. Gilmore Jr.  
State University of New York at Buffalo, Buffalo, NY 14226  
IEEE Trans. Aerospace And Electron. Sys., Vol. AES-13, No. 6 pp 660-678 (11/1977).

The power conditioning portion of the high-power study that was performed for the Air Force Aerospacelab Laboratory by the State University of New York at Buffalo is summarized. This effort defines the power conditioning system and critical component developments which will be required to interface the airborne 10-MW to 50-MW sources defined under separate study efforts with certain loads. Power conditioning systems are considered for use with magnetohydrodynamic generators and turbine driven alternators, both conventional and superconducting. The critical components required for each of the power conditioning systems are identified and then analyzed. The component analyses include estimations of development efforts necessary and of specific weights and volumes for components. The primary components considered are transformers (for alternator as well as for inverter use), switches, capacitors, and inductors. Weight algorithms are developed for each of the components. Following the component analyses, subsystems such as inverters and rectifier and filter packages are considered. The data for the various components and subsystems are then utilized for a comparison of the power conditioning techniques to be used with the various power conditioning systems. The weights and volumes of power conditioning systems for 8-point designs (8 variations of power, voltage, duty cycle, and total run time) are derived. 23 Refs.

Primary Keywords: Transformer; Switch; Capacitor; Inductor; Light Weight; Subsystem  
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4806  
(ENERGY STORAGE, INDUCTIVE)  
(Systems)

0.54-MJ SUPERCONDUCTING MAGNETIC ENERGY TRANSFER AND STORAGE  
J.D. Rogers (1), D.J. Blewett (1), J.D.G. Lindsay (1), G.A. Miranda (1), C.E. Swannack (1), D.M. Weldon (1), J.J. Mollan (2), C.J. Moles (2), E. Mullan (2), P.W. Eckels (2), H.E. Heller (2), M.A. Janocko (2), S.A. Karpach (2), DC Litz (2), P. Reichner (2), Z.N. Sanjano (2) and M.S. Walker (2)  
(1) Los Alamos National Labs, Los Alamos, NM 87545  
(2) Westinghouse Electric Corp, Pittsburgh PA  
LASL Report No. LA-UR-77-1312 (08/1977).  
Availability: LA-UR-77-1312  
NTIS

A superconducting energy storage coil designed to store 300 kJ of energy was operated with stored energy up to 0.54 MJ. The energy was transferred from the coil in periods from 1 to 2.4 ms. Hysteresis loss and losses from all effects during pulsed energy transfer were observed. The coil is described and the test results are presented. Also included is a description of a METS (magnetic energy transfer and storage) driven adiabatic plasma compression system for a large toroidal theta-pinch reactor test and of a 300-kJ, monolithic conductor, superconducting pulsed energy storage coil. 27 Refs.

Primary Keywords: Superconducting Coil; Hysteresis loss; Monolithic Conductor  
Secondary Keywords: Theta-pinch

4819  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Electrodes; Gas Gaps, Materials)  
CURRENT DENSITY IN ELECTRODE SPOTS OF ARC WITH METAL ELECTRODES  
P.V. Sergeev and G.A. Shepel'  
Journal Of Engineering Physics, Vol. 17, No. 6 pp 1589-1594 (12/1969).  
Trans. From: Inzhenerno-Fizicheskii Zhurnal 17, 1041-1049 (December 1969)

The dependence of the total current density in the spots on its different components and the current is examined by considering the energy balance of the electrode sheaths. The factors affecting electrode erosion are determined. Results of measurements of the current density on spots on iron electrodes in arcs with different currents are given. 3 Refs.

Primary Keywords: DC Arc; Current Density; Graphitized Refractory Electrode; Metal Electrode; Electrode Sheath; Power Balance  
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4851  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
MEASUREMENT OF THE ELECTRON TEMPERATURE OF THE PLASMA OF A QUASI-STABLE PULSED GLOW DISCHARGE IN SPARK GAPS WITH HIGH OVERVOLTAGES  
V.V. Osipov, R.B. Bakshi, Yu.I. Bychkov and A.G. Filonov  
Optics And Spectroscopy, Vol. 33, No. 5, pp 459-461 (05/1972).

A quasi-stable glow discharge in helium at 30 and 100 Torr is studied. The discharges for several electrode separations are analyzed spectroscopically and the results obtained are used to calculate the electron temperature of the plasma. Measurements taken of gap voltage and current allow the electron concentration to be calculated. 4 Refs.

Primary Keywords: Glow Discharge; Pulsed Discharge; Helium; Plane Electrodes; Parallel Electrodes  
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4876  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
STUDY OF A 40 KV MULTISTAGE SPARK GAP OPERATED IN AIR AT ATMOSPHERIC PRESSURE

A. Anvari and O. Steinvall  
Institute of Physics, University of Uppsala, Uppsala, Sweden  
Journal Of Physics E: Scientific Instruments, Vol. 6, No. 11, pp 1113-1115 (07/1973).

The electrical properties of a multistage spark gap have been studied and a compact 40 kV four-stage switch is described. The switch can be operated in atmospheric air with a 50 ns delay time and a  $\pm 5$  ns jitter, when triggered at breakdown voltage. Both these values are shorter, by a factor of 3, than those of a similar two-electrode spark gap. The discharge gaps, besides the electrical connection, have been coupled to each other, optically, by means of an axial hole through the switch. This coupling, which gives rise to a simultaneous ignition in the gaps, is mainly responsible for reduction of the jitter and the delay time. The simultaneity of the gap ignitions has been shown by investigating the short light pulses (about 2 ns halfwidth) emitted from the spark of each gap. The switch is also capable to work with high repetition rate. More than 1200 Hz with a 4 kA peak current has been obtained, when operating the switch in air at atmospheric pressure. 6 Refs.

Primary Keywords: Multistage Spark Gap; Four-stage Spark Gap; 5 NS Jitter; Optical Coupling; Rep-rated

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4875  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
THE EFFECT OF IONIZATION AND FLOW VELOCITY UPON SPARK GAP RECOVERY

R.M. Clemens (1) and P.R. Smy (2)

(1) University of Victoria, Victoria, British Columbia, Canada

(2) University of Alberta, Edmonton, Alberta, Canada

Journal Of Physics D: Applied Physics, Vol. 6, No. 10, pp 1253-1265 (06/1973).

Breakdown measurements for a small cylindrical cathode in an atmospheric-pressure flowing plasma of variable ionization (between 1E15 and 1E18 m/sup -3/) are reported for both DC voltages and fast-rise pulses (rise time 0.16 microsecond) applied to the cathode. For these measurements the breakdown voltages are found to be reduced to as little as 1/6 of the breakdown voltage with no ionization. The measurements agree reasonably well with a theoretical model in which the anode is not the positive electrode in the plasma, but rather the edge of the coaxial sheath which surrounds the cathode, with breakdown voltages being given by the well-known breakdown relation for coaxial gaps. (For cylindrical geometry and a thick sheath, the ion space charge in the sheath is shown not to change materially the electric field from its value calculated for a conventional coaxial gap of the same dimensions.) In this experiment the impedance of the plasma between the sheath edge and the actual positive electrode is low enough for breakdown not to occur over this region. It is expected that this model will be used to predict reignition voltages at short recovery times in circuit breakers. 15 Refs.

Primary Keywords: Breakdown Measurement; Flowing Plasma; Variable Ionization; DC Voltage; Impulse Voltage

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4880  
(PULSE GENERATORS)  
(Blumlein Lines)  
THREE-ELECTRODE BLUMLEIN LINE FOR SUPPLYING A STREAMER CHAMBER

V.S. Chirchkin and S.B. Shauly

Physics Institute, Academy of Sciences of the USSR, Moscow, USSR

Instruments And Experimental Techniques, Vol. 15, No. 5, pp 1328-1330 (10/1972).

Trans. From: Pribery I Tekhnika Eksperimenta 5, 38-40 (September-October 1972)

The construction of a Blumlein line and a shaping spark gap is described which produces pulses having an amplitude of 260 kV and a length of 13 nsec. 3 Refs.

Primary Keywords: Design Considerations; 25 Ohm Line Impedance; 50 Ohm Load Impedance; Marx Generator

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4887  
(PULSE GENERATORS)  
(Blumlein Lines)  
A COMPACT HIGH SPEED LOW IMPEDANCE BLUMLEIN LINE FOR HIGH VOLTAGE PULSE SHAPING

J.H. Crouch and M.S. Risk  
University of Maryland, College Park, MD 20742  
The Review Of Scientific Instruments, Vol. 43, No. 4, pp 632-637 (04/1972).

Design, construction, and operation of a low impedance Blumlein line are presented. Glycerol was used as a dielectric to obtain a 14.5 ohm line which in conjunction with a Marx generator driver could produce 5 nsec long 240 kV pulses. The line, which is small enough to be housed in a Lucite box 30 cm wide x 30 cm long x 13 cm thick, was used to drive a bank of four 2.2 m long x 30 cm wide x 7.62 cm gap streamer chambers. Properties of the Blumlein line with water as the dielectric are also given and limitations on further shortening of the pulse are discussed. 16 Refs.

Primary Keywords: Blumlein Line; Low Impedance; Glycerol Dielectric; Water Dielectric; Small Size

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4889  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
A COMPUTER SIMULATED MODEL FOR DIFFUSION AND DRIFT OF ELECTRONS IN FLASH TUBES

F.M. Mollroyd and J.M. Breese  
University of Durham, Durham, UK  
Nuclear Instruments And Methods, Vol. 100, No. 2, pp 277-280 (04/1972).

A Monte Carlo method is used to solve the equation of diffusion and drift of electrons in a flash tube, taking into account the formative distance of the discharge. Hence the efficiency as a function of delay between the passage of an ionizing particle and the application of the high voltage pulse is found, for different electron drift velocities. Comparison of experimental efficiencies with these results enables an estimate to be made of the electric fields built up in flash tubes when they are operated at high repetition rates. 8 Refs.

Primary Keywords: Flash Tube; Numerical Calculation; Monte Carlo Calculation; Electron Diffusion; Electron Drift; Rep-rated; E-field Buildup

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4890  
(DIAGNOSTICS AND INSTRUMENTATION)  
(E-field)  
A CYLINDRICAL ELECTROSTATIC FLUXMETER FOR CORONA STUDIES

R.T. Metts  
UMIST, Cardiff, UK

Journal Of Physics E: Scientific Instruments, Vol. 5, pp 475-478 (05/1972).

The electric field at a high voltage electrode is modified by corona discharge in the space surrounding the electrode. A knowledge of the resultant magnitude of the electric field is of value in the theoretical analysis of the corona. Systems of cylindrical geometry are of particular importance because of applications in electrostatic precipitators and in power loss from overhead transmission lines. The earlier methods of field measurement in corona discharges have not been suitable for measurement of the field strength at the electrode surface, especially in the case of power-frequency corona. The paper describes a new technique employing a cylindrical rotating electrostatic fluxmeter. The device is capable of differentiating between conduction and displacement current when used as part of an active corona electrode. 11 Refs.

Primary Keywords: E-field Measurement; Corona; Cylindrical Geometry; Rotating Fluxmeter; Power Frequencies

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4897  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
ALTERNATE POLARITY MULTIPLE SPARK GAP FOR HIGH EFFICIENCY SHOWER DETECTORS

C. De Marzo (1), L. Guerriero (1), C. Nicolini (1), F. Posa (1), G. Chen (2), C.R. Fletcher (2), R.E. Lanou Jr. (2), L. Rosenson (3) and R. Thern (3)

(1) University di Bari, Bari, Italy

(2) Brown University, Providence, RI

(3) Massachusetts Institute of Technology, Cambridge, MA

Nuclear Instruments And Methods, Vol. 97, No. 3, pp 539-545 (12/1971).

The developments in the HV pulsing system which have been made in order to reduce the rise time and the delay of the HV pulse at the plates of a large spark chamber system are reported. Higher efficiency has been achieved feeding each chamber through an alternate polarity multiple spark gap. 0 Refs.

Primary Keywords: Low Inductance; Stainless Electrode; Spark Plug Trigger; Alternate Polarity

Secondary Keywords: Spark Chamber

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4910  
(SWITCHES, OPENING)  
(Mechanical)  
DIELECTRIC RECOVERY AND SHIELD-CURRENTS IN VACUUM-ARC INTERRUPTERS

C.W. Kimbly

Westinghouse Research and Development Center, Pittsburgh PA

IEEE Transactions On Power Apparatus And Systems, Vol. PAS-90, No. 3, pp 1261-1270 (06/1971).

Dielectric recovery data is presented following forced current interruption of 930 A DC copper vapor arcs in a vacuum interrupter. At given free recovery periods during the first 6 to 25 microsec.

Following interruption, the instantaneous dielectric strength is determined by the application of high voltage step function pulses. This instantaneous dielectric strength is defined as the maximum voltage which can be consistently reapplied without causing reignition. The influence of electrode spacing (0.6 or 1.3 cm), shield potential and polarity of the reapplied voltage on the recovery of dielectric strength have been determined. The more rapid rate of recovery initially observed at long spacings is attributed to the lower mean inter-electrode vapor density immediately following interruption. Recovery is also more rapid for 'reverse' rather than 'same' polarity reapplication indicating surface effects, in particular the roughening of the cathode surface during arcing. Post arc currents lead to an initial reduction of dielectric strength for 'reverse' reapplication with the vapor shield tied to the 'arcing-anode'. The mechanism of these post arc currents has been investigated by observations of the high ion currents which flow to a negatively biased shield during and immediately following arcing. 16 Refs.

Primary Keywords: Vacuum Arc; Copper Electrode; Dielectric Strength; Temporal Resolution; Variable Electrode Spacing; Variable Shield Potential

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4914  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
EPOXY RESIN CHAMBER FOR HIGH VOLTAGE BREAKDOWN STUDIES IN HIGH VACUUM

B.R. Prabakar and M.R. Nandagopal

Indian Institute of Science, Bangalore, India

Vacuum, Vol. 22, No. 2, pp 47-50 (02/1972).

As the study of electrical breakdown phenomena in vacuum systems gains more importance, a thorough understanding of the breakdown mechanism at high voltages necessitates a chamber for experimental studies. An epoxy-resin chamber has been constructed by casting ring sections which were joined together. The advantages of such a chamber over the conventional metal or glass chamber are given especially as regards the electric field configuration, high voltage lead-in, and the ease of construction. Special facilities can be incorporated while constructing the chamber which makes it more versatile; for example, in pre-breakdown current measurements, electron beam focusing studies, etc. 5 Refs.

Primary Keywords: Vacuum Breakdown; Breakdown Chamber; Epoxy Resin Construction; Field Configuration

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4917  
(PULSE GENERATORS)  
(Marx)  
FIRING AND VOLTAGE SHAPE OF MULTISTAGE IMPULSE GENERATORS

F.M. Heilbronner

Hochspannungsinstitut, Technical University, Munich, Germany

IEEE Transactions On Power Apparatus And Systems, Vol. PAS-90, No. 3, pp 2233-2238 (10/1971).

The calculation of electromagnetic transients is applied to an impulse generator circuit of n stages with the overvoltage behaviour of the spark-gaps taken into account. Measurements of the impulse voltage by a damped-capacitive divider and of the subsequent firing of the sphere gaps by streak photography with an image converter camera illustrate good agreement between equivalent model and actual circuit. 14 Refs.

Primary Keywords: Marx Generator; Experiment; Theory; Modeling; Analytical Calculation; Performance Prediction; Pulse Shape Prediction

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4919  
(BREAKDOWN STUDIES; INSULATION, MATERIAL)  
(Surface Flashover; Solid)  
(Surface Flashover Tests On Dust-Contaminated Insulators)  
F.A.M. Risk and A.A. Assad  
Electricity Corp. UAR  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-91, No. 1,  
pp 328-335 (02/1972).  
This paper describes a high voltage laboratory testing program of  
artificially dust-contaminated cap and pin insulators. Several  
factors are found to influence the flashover characteristics  
including: the method of voltage application, the rate of wetting of  
the contaminated insulators, and the duration of the high voltage  
test. The 50% flashover voltage is found to be proportional to the  
number of insulator units per string while the relative dispersion  
decreases considerably for longer strings, within the range  
investigated. Flashover characteristics of artificially and naturally  
contaminated insulators are compared. Due consideration is given to  
the statistical nature of the problem which determines the volume of  
the tests involved. Flashover values are shown to belong to a  
population characterized by a Gaussian distribution and a procedure  
for optimizing the number of necessary tests is developed. 16 Refs.  
Primary Keywords: Surface Flashover; Surface Contamination; Cap  
Insulation; Pin Insulation; Artificial  
Contamination; Natural Contamination  
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4931  
(SWITCHES, CLOSING)  
(Gas Gaps, E-beam)  
INITIATION OF A DISCHARGE IN A MEGAVOLT GAS SPARK GAP BY AN ELECTRON  
BEAM  
E.A. Abramyan, V.V. Borob'ev, A.A. Egorov, V.A. Elkin and A.G.  
Ponomarev  
Nuclear Physics Institute, Academy of Sciences of the USSR, Novosibirsk  
Instruments And Experimental Techniques, Vol. 14, No. 1, pp 130-131  
(02/1971).  
Trans. From: Priory 1 Tekhnika Eksperiments 14, 117-118  
(January-February 1971).  
The preliminary results of experiments on the excitation of a  
discharge in a gas spark gap under a high pressure by means of an  
external injection of an electron beam are presented. The study of  
nanosecond commutation of megavolt gaps is designed for plasma  
research, work in the field of accelerators, and work in nanosecond  
engineering. 5 Refs.  
Primary Keywords: E-beam Triggered Spark Gap; Delay Measurement;  
Nitrogen Gap; Low Current Beam  
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4932  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
IONIZING POTENTIAL WAVES AND HIGH-VOLTAGE BREAKDOWN STREAMERS  
M.M. Albright and D.A. Tidman  
University of Maryland, College Park, MD 20742  
The Physics Of Fluids, Vol. 13, No. 1, pp 86-98 (01/1972).  
The structure of ionizing potential waves driven by a strong  
electric field in a dense gas is discussed. Negative breakdown waves  
are found to propagate with a velocity proportional to the electric  
field normal to the wavefront. This causes a curved ionizing  
potential wavefront to focus down into a filamentary structure, and  
may provide the reason why breakdown in dense gases propagates in the  
form of a narrow leader streamer instead of a broad wavefront. 10  
Refs.  
Primary Keywords: Potential Wave; Negative Breakdown Wave; Filamentary  
Structure; Theory  
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PERMISSION

4933  
(PULSE GENERATORS; SWITCHES, CLOSING)  
(Trigger; Avalanche Transistors, Optical)  
LASER-TRIGGERED AVALANCHE-TRANSISTOR VOLTAGE GENERATOR FOR A PICOSECOND  
STREAK CAMERA  
S.M. Thomas and L.M. Coleman  
Lawrence Livermore Lab, Livermore, CA 94550  
Applied Physics Letters, Vol. 28, No. 2, pp 83-84 (01/1972).  
Direct optical triggering of an avalanche transistor with a short  
laser pulse has been demonstrated. In some applications this system  
provides a compact low-jitter replacement for a laser triggered spark  
gap. The technique has been applied to generating the gating and  
sweep voltages in a picosecond streak camera for laser pulse  
diagnostics where it eliminates the need for multiple beam splitters  
and long delay. The "trigger" avalanche transistor was placed as one  
of a series string of avalanche transistors. A portion of the  
switch-out laser pulse to be diagnosed was focused onto the trigger  
transistor chip. Nanosecond-rise kilovolt waveforms are thus  
generated with time jitter of the entire system being less than 100  
psec. 4 Refs.  
Primary Keywords: Avalanche-transistor; Series String; Laser Trigger;  
Subnanosecond Jitter; Nanosecond Trigger Energy  
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4935  
(PARTICLE BEAMS, ION)  
(Generation)  
PRODUCTION OF INTENSE DEUTERON BEAMS  
J. Golden and C.A. Kapetanakis  
Naval Research Lab, Washington, DC 20375  
Applied Physics Letters, Vol. 28, No. 1, pp 3-4 (01/1972).  
Results are reported on the production of 400-keV 50-nsec-duration  
1.3-kA deuteron beams using a reflex triode. 11 Refs.  
Primary Keywords: Ion Beam Generation; Reflex Triode; 1.3 kA Current;  
Field-reversing Ion Layer; Ion Ring  
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4941  
(PULSE GENERATORS)  
(Blue/In Lines)  
OPERATIONAL EXPERIENCE WITH A PROTOTYPE FAST KICKER MODULATOR  
M. Fruitman  
Brookhaven National Lab, Upton, NY  
IEEE Transactions On Nuclear Science, Vol. NS-18, No. 3, pp 962-963  
(03/1971).  
The modulator built to test components for the proposed AGS fast  
kicker operated at 800 MHz peak output for 1700 hours. Its unique  
circuit is described and the operating conditions are listed. The  
results of the testing of various high power components are  
discussed. 2 Refs.  
Primary Keywords: Blue/In Line; Design Considerations; Performance  
Test; Component Selection; Dummy Load Design  
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4944  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES)  
(Gas, Electrical; Electrodes)  
PERFORMANCE OF SPHERE AND ROD-ROD GAPS UNDER HIGH DIRECT VOLTAGES  
A. Colombo and M. Mosca  
CESI-Centro Elettrotecnico Sperimentale Italiano, Milan, Italy  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-91, No. 2,  
pp 581-518 (04/1972).  
Up to now there is no detailed study dealing with the problems  
concerning the measurements of the highest DC voltages. The sphere  
gap is the only device recognized and normally used, but there are  
many doubts on its behaviour especially as far as the accuracy is  
concerned. Additional causes of uncertainty are related to correction  
factors for atmospheric conditions and to the exact knowledge of the  
characteristics of very high ohmic voltage dividers, for which a  
precise and therefore difficult calibration must be required. This  
paper reports the results of a research on the behaviour of the  
sphere-gaps. The performance of the rod-rod gap is also examined with  
a view to the possibility of using it as a measuring device. Finally  
the problem of defining a withstand test voltage is briefly  
discussed. 12 Refs.  
Primary Keywords: DC Voltage; Sphere-sphere Gap; Rod-rod Gap; Voltage  
Measurement; Self-breakdown; Voltage Scatter;  
Variable Gap Spacing  
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4945  
(SWITCHES, CLOSING)  
(Gas Gaps, Optical)  
PICOSECOND TRIGGERING OF A LASER-TRIGGERED SPARK GAP  
R.J. Dewhurst, G.J. Part and S.A. Ramsden  
University of Hull, Hull, UK  
Journal Of Physics D: Applied Physics, Vol. 5, pp 97-103 (01/1972).  
The characteristics of laser-triggered spark gaps, initiated by a  
switched-out pulse of about 7 ps from a mode-locked Nd:glass laser  
system, are investigated. The formation time delay of breakdown  
across the gap can be of the order of 1 ns and is found to increase  
as the gap voltage is reduced. Comparison with spark gaps triggered  
by Q-spilled nanosecond laser pulses is made. Finally, a comparison  
of the agreement between the experimental results and theory suggests  
that the initiation of gap breakdown is due to the production of only  
a few free electrons from the electrode surface on which the laser  
beam is focused. 15 Refs.  
Primary Keywords: Nd-glass Laser; Mode Locked Laser; Single Triggering  
Pulse; Formative Time Lag; Experiment; Theory  
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4948  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
PREBREAKDOWN PHENOMENA IN STANDARD ROD GAPS SUBJECTED TO IMPULSE  
VOLTAGES  
J.E. Matthews and R. Saint-Arnaud  
University of Strathclyde, Glasgow, Scotland  
Proceedings Of The IEE, Vol. 118, No. 10, pp 1528-1534 (10/1971).  
The characteristics of the prebreakdown corona and leader formation  
for impulse voltages in this paper. The gap was a rod-rod gap with up  
to 30 cm spacing and applied voltage of 400 kV. The times to corona  
onset, leader formation, and main stroke were measured, along with  
the number of current pulses (to be correlated with leader steps).  
From this, the average voltage at corona onset, propagation speeds of  
corona and leaders, and average leader step length were derived. 28  
Refs.  
Primary Keywords: Corona; Leader Step Corona Voltage; Impulse Voltage;  
Rod-rod Gap  
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4950  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
RELATIVISTIC BRILLOUIN FLOW IN THE HIGH MU/GAMMA DIODE  
J.M. Creedon  
Physic International Co, San Leandro, CA 94577  
Journal Of Applied Physics, Vol. 46, No. 7, pp 2946-2955 (07/1975).  
Relativistic Brillouin solutions have been derived for electron  
flow in crossed electric and magnetic fields. The application of  
these solutions to the high mu/gamma diode is discussed and an  
approximate analytical expression for the anode current is derived.  
Measurements of diode current are compared to the theoretical and  
empirical expressions for diode current which have been developed.  
39 Refs.  
Primary Keywords: Field Emission Diode; Electron Flow; Brillouin Flow;  
Magnetic Field; Experiment; Theory  
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PERMISSION

4960  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
THE FORMATION AND GROWTH OF A STABILIZED SPARK DISCHARGE  
J.P. Walters  
University of Wisconsin, Madison, WI  
Applied Spectroscopy, Vol. 26, No. 3, pp 323-354 (06/1972).  
Experiments are described in which stabilized spark discharges in  
nitrogen and argon at atmospheric pressure are studied. The  
discharges were generated by a quarter wave, current injection spark  
source at rates up to 300/sec. Optical spectrometers, photoelectric  
detection systems, and forming cameras were used to examine the  
formation of the plasma, the growth of the current flow, and the  
radiance of the spark. An analysis of discharge formation mechanisms  
involving metastable argon is presented. Electrode erosion is also  
discussed. 39 Refs.  
Primary Keywords: Atmospheric Pressure Discharge; Nanosecond Time  
Scale; Spark Charge; Electrode Erosion; Spectral  
Output; Metastable Argon  
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4963  
(SWITCHES, CLOSING)  
(Gas Gaps, Optical)

S.H. Khan and D. Phil  
University of Oxford, Oxford, UK  
The Radio And Electronic Engineer, Vol. 41, No. 10, pp 475-480  
(10/1971)

#### THE LASER TRIGGERED SPARK GAP

There is considerable interest in switching high voltages in the range of 10-1000 kV, with the minimum of delay and jitter. Delays of a few nanoseconds with assured, reasonable freedom from jitter are of considerable importance in work requiring synchronization, such as the pulsed line acceleration of electron rings. The general requirements of a spark-gap switch are two-fold: (a) it must be able to take the full voltage applied to it; and (b) it must be able to conduct on demand. For this it is necessary that enough primary electrons be present to initiate the discharge and the gap voltage must be sufficiently high. The primary electrons are generally provided by ultraviolet or other irradiation of the gap. While a third or fourth trigger electrode is used to supply a voltage pulse that would disturb an existing voltage distribution and provide sufficient gap voltage. Such methods work quite well up to 70-80 kV, beyond which the problems posed by proper insulation and voltage division are quite enormous. The laser offers an alternative triggering device which is basically safer and simpler to use as it is isolated electrically from the spark gap. Moreover, a two-electrode configuration has obvious advantages from the engineering design point of view. 22 Refs.

Primary Keywords: Air Gap; Variable Gap Spacing; Experiment; Theory  
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4978  
(PULSE GENERATORS; ENERGY STORAGE, CAPACITIVE)  
( Marx; Marx Generators)

500-KV IMPULSING GENERATOR  
A.I. Pavlovskii, V.S. Bosomykin, A.I. Gerasimov and A.P. Klement'ev  
Instruments And Experimental Techniques, Vol. 14, No. 4, pp 1075-1077  
(08/1971)  
Trans. From: Priroda i Tekhnika Eksperimenta 4, 112-114 (July-August 1971)

A 10-stage Arkad'ev-Marx generator is described having a coaxial discharge impulsing circuit with a maximum voltage of 500 kV; the generator serves as the power supply for a high-current electron gun. The inductance of the generator is 1.2 microhenry. The spark gap of the first stage is gas-filled (N<sub>2</sub> at approximately 3 atm), while the subsequent spark gaps are air gaps; five trigatrons with automatic firing from the operation of the preceding stage, and four two-electrode spark gaps. The duration of the flat top of the output pulse is controlled by a cutoff spark gap. The time distribution of the breakdown of the spark gaps is given, as well as the dependence of the generator operating time on the number of trigatron spark gaps. 4 Refs.

Primary Keywords: Marx Generator; 500 kV Output Voltage; Rectangular Pulse; Spark Gap; 10 ns Rise Time  
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4977  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
A NEW DIODE FOR THE PRODUCTION OF HIGH POWER RELATIVISTIC ELECTRON BEAMS  
M. Friedman  
Cornell University, Ithaca, NY 14850  
The Review Of Scientific Instruments, Vol. 42, No. 8, pp 1255-1256  
(08/1971)

A new type of low impedance diode has been developed to produce pulsed relativistic electron beams. Using a multicathode system, the diode impedance was lowered to approximately 4 ohm. Currents of approximately 60 kA and voltages of approximately 250 kV have been obtained. 7 Refs.

Primary Keywords: Low Impedance Diode; Multicathode System; Foilless Diode  
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4983  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Systems)

#### A SPARK GAP MONITOR

D. Brown  
Los Alamos National Labs, Los Alamos, NM 87545  
The Review Of Scientific Instruments, Vol. 42, No. 9, pp 1287-1291  
(09/1971)

A relatively simple method for determining the delay of many electrical signals with respect to a common trigger (e.g., in capacitor banks) is described. Using the well known principle of time-to-pulse-height conversion, a low leakage polystyrene capacitor is charged to a voltage proportional to the delay. A read relay is used to disconnect the capacitor from the charging circuit, which permits the charge to be maintained on the capacitor for many seconds. Another read relay is employed to connect each capacitor to an ADC when it is desired to digitize the charge on the capacitor. A change in delay of less than 1 nsec (with a full scale of 200 nsec) is reliably detected for many hundreds of signals at a parts cost of less than \$16 per signal. 8 Refs.

Primary Keywords: Signal Delay Measurement; Capacitor Charging; Time-to-pulse-height Conversion  
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4990  
(INSULATION, MATERIAL)  
(Solid)

#### COMPARISON OF TRACKING TEST METHODS

M. Kurtz  
Ontario Hydro Research, Toronto, Ontario, Canada  
IEEE Transactions On Electrical Insulation, Vol. EI-6, No. 2, pp 76-81  
(06/1971)

A selection of epoxy specimens has been subjected to a number of different tests for track resistance. The degree of agreement between testing agencies using the same method, and between the different test methods is described. Generally speaking, those methods, which impose alternate wet-dry cycles, or otherwise simulate the 'dry-banding' effects that occur in service, appear to classify materials in the 'correct' order, that is, in best agreement with each other, and with actual outdoor performance. The superior track resistance of cycloaliphatic systems, and the further improvement consequent upon the use of hydrated alumina filler are confirmed. Details of the Tracking Endurance Wheel Test method are given in the Appendix. 4 Refs.

Primary Keywords: Insulation Tracking; Epoxy Resin; Several Specimens; Dry Banding; Cycloaliphatic Material; Outdoor Operation; Power Line Frequency  
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4998  
(SWITCHES, CLOSING)  
(Gas Gaps, Optical)

#### EFFECT OF CATHODE MATERIAL IN A LASER TRIGGERED SPARK GAP

S.H. Khan and D. Walsh  
University of Oxford, Oxford, UK  
Journal Of Physics D: Applied Physics, Vol. 4, pp 344-347 (10/1970)

The use of refractory material like tungsten for the target electrode causes faster switching of a laser triggered spark gap. This is believed to be due to the faster local heating to a higher temperature which causes a greater injection of plasma into the gap. Reliable switching with a formative time of less than 10 ns has been achieved. 4 Refs.

Primary Keywords: Refractory Electrode Material; Faster Local Heating; More Plasma; Faster Switching  
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4999  
(ENERGY STORAGE, MECHANICAL; PULSE GENERATORS; SWITCHES, OPENING)  
(Rotating Machines; Systems; Mechanical)  
FAST CIRCUIT BREAKER FOR THE DISCHARGE OF A STORAGE INDUCTOR  
E.K. Inall

Australian National University, Canberra, Australia  
Nature Physical Science, Vol. 231, No. 22, pp 111-112 (05/1971)

The authors report a scheme to transfer energy from a homopolar generator to a resistive load. The homopolar generator is discharged into an inductor to be discharged into a load. The heart of the apparatus is a switch/fuse combination that allows a power multiplication of over 200 when opened. 2 Refs.

Primary Keywords: Homopolar Generator; Toroidal Inductor; Mechanical Circuit Breaker; Fuse; Resistive Load; Power Multiplication  
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5027  
(POWER CONDITIONING)  
(Pulse Transformers; Materials)  
REVIEW OF MAGNETIC PROPERTIES OF FE-NI ALLOYS  
G.Y. Chin

Bell Labs, Murray Hill, NJ 07974  
IEEE Transactions On Magnetics, Vol. Mag-7, No. 1, pp 102-113 (03/1971)

During the past two decades, improved understanding of the fundamental magnetic behavior of Fe-Ni alloys has made them one of the most versatile classes of soft magnetic materials. No longer is the concern limited to high permeability and low coercive force at room temperature. Alloys have now been custom-crafted to meet high permeability requirements at cryogenic temperatures, exhibit a skewed hysteresis loop for pulse transformer use, or a square hysteresis loop combined with stress insensitivity and controlled coercive force for memory applications. These examples are discussed in terms of the relationship of magnetic properties to structure and composition in Fe-Ni alloys. 90 Refs.

Primary Keywords: Fe-Ni Alloy; Room Temperature; Cryogenic Temperature; Skewed Hysteresis Loop; Pulsed Transformer

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5033  
(PULSE GENERATORS)  
(Trigger)  
SPARK GAP TRIGGER AMPLIFIER WITH 1-MSEC RECOVERY TIME  
C.C. Lo

Lawrence Berkeley Lab, Berkeley CA  
Nuclear Instruments And Methods, Vol. 92, No. 2, pp 299-308 (03/1971)

A spark-gap trigger amplifier with 1-msec recovery time has been developed for experiments using spark chambers with fast recovery time. The system utilizes a spark gap operating under the ambient pressure as the high-current fast switching element, and is entirely self-contained. The system is capable of operating at 1 kHz for 1 sec burst, or 400 Hz continuously. 2 Refs.

Primary Keywords: Trigger Amplifier; 8 kV Output Pulse; Leakage Current; Field Distortion Spark Gap; Corona Lamp  
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5045  
(SWITCHES, CLOSING)  
(Gas Gaps, Recovery)  
THE INFLUENCE OF FORMATIVE TIME LAGS ON SPARK-GAP RECOVERY MEASUREMENTS  
F.L. Curzon and M.S. Gault  
University of British Columbia, Vancouver, British Columbia, Canada  
Journal Of Physics D: Applied Physics, Vol. 4, No. 2, pp 341-343  
(02/1971)

This note shows that the observed lack of density variations for formative time lags of sparks can be explained by the known pressure and electric field dependences of the first Townsend ionization coefficient and the electron drift velocity. It is demonstrated that the time lag varied linearly with gap length and inversely as the fractional over-voltage across the spark gap (in agreement with the measurements of Blair and Farish). Finally, it is demonstrated that the accuracy of the error in the measured 'restriking' voltage for a recovering spark channel is constant for the complete recovery period. 11 Refs.

Primary Keywords: Formative Time Lag; First Townsend Coefficient; E-field Dependence; Pressure Dependence; Recovery  
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5047  
(INSULATION, MATERIAL)  
(Solid)  
THERMAL EROSION OF ELECTRICAL INSULATING MATERIALS

M.J. Billings (1), L. Warren (2) and R. Wilkins (3)  
(1) British Oxygen Co., Crawley, Sussex, UK  
(2) University of Manchester, Manchester, UK  
(3) University of Ankara, Ankara, Turkey  
IEEE Transactions On Electrical Insulation, Vol. EI-6, No. 2, pp 82-90  
(06/1971)

The erosion of synthetic insulating materials by surface discharges constitutes an important problem in the application of these materials for high-voltage outdoor applications. A method of erosion testing is described that simulates the heat flux from surface discharges by radiant energy from a thermal imaging source. This permits accurate measurement of erosion. A theory of erosion is developed that is found to agree well with experiments performed on several cycloaliphatic epoxy resin systems. 4 Refs.

Primary Keywords: Cycloaliphatic Epoxy Resin; Surface Tracking; Thermal Erosion; Thermal Imaging Device; Experiment; Theory  
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48

5104  
(POWER CONDITIONING)  
(Peaking Gaps)  
LOW-VOLTAGE SPARK PEAKER  
D.S. Kolotov and V.A. Pogozhev  
Moscow State University, Moscow, USSR  
Instruments And Experimental Techniques, No. 3, pp 677-679 (05/1969).  
Trans. From: Pribery i Tekhnika Eksperimenta 3, 130-133 (May-June 1969).  
A spark peaker for shaping pulses of approximately 1 kV is described and the results of a test of its performance are considered. The spark peaker operates periodically and shapes pulses with a rise time of  $0.5 \pm 0.1$  nsec and a triggering-time instability of  $0.15 \pm 0.2$  nsec. 7 Refs.  
Primary Keywords: Spark Gap; Peaking Gap; 1 kV Voltage; Subnanosecond  
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5105  
(SWITCHES, CLOSING)  
(Vacuum Gaps, Electrical)  
MULTICHANNEL VACUUM SPARK GAP  
A.I. Babaritskii, B.A. Demidov, S.D. Fanchenko and V.V. Frolov  
Institute Of Atomic Physics, Moscow, USSR  
Instruments And Experimental Techniques, No. 3, pp 718-720 (05/1969).  
Trans. From: Pribery i Tekhnika Eksperimenta 3, 167-169 (May-June 1969).  
A two-electrode vacuum spark gap having the configuration of a slot in a dielectric with three firings distributed along the electrodes is studied with a high-speed electron-optical camera. It is shown that over the wide voltage range of 10-80 kV all three current channels develop simultaneously, which reduces inductance to a minimum. 4 Refs.  
Primary Keywords: Three Channel Operation; Plasma Gun; Three Guns; Low Jitter; Holdoff Voltage Reproducibility  
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5119  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
A NEW HIGH-VOLTAGE TRIGGERED SPARK GAP  
T.E. Broadbent  
University of Manchester, Manchester, UK  
British Journal Of Applied Physics, Vol. 15, pp 97-99 (01/1964).  
The trigatron type of spark gap and the hot-wire gap are combined into a single device in which a trigger spark is produced near a heated filament at the sparking surface of one main electrode. The breakdown voltage of the gap, when triggered, is considerably lower than the corresponding breakdown voltage for the two constituent gaps separately, provided the applied voltage is negative. By adjusting the wire temperature the range of voltage over which satisfactory triggering occurs can be controlled, without the need to adjust the gap spacing. 4 Refs.  
Primary Keywords: Trigatron Gap; Hot-wire Trigger; Combination; Polarity Effects; Wide Voltage Range  
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5120  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Electrodes; Gas Gaps, Materials)  
SURVEY OF EFFECT OF SURFACE PROPERTIES ON ANODE EROSION  
M.S. Resor  
Aerospace Research Labs, Wright-Patterson AFB, OH  
No. ARL-68-8069, 29pp (04/1968).  
Availability: AD-671 503  
NTIS  
Anode erosion is a serious problem in high power electric arcs and appears to be due primarily to intense local heating. Three means are considered for amelioration: improved heat transfer from the anode spot, broadening of the anode spot (decreased power density), and reduction of total anode power dissipation. Low work function 'patches' may create preferred arc attachment points. Surface composition, structure, and preparation can have major influence, and means are discussed for tailoring anode surface properties. (Author)  
Primary Keywords: Gas Discharges; Anodes (Electron Tubes); Anodes (Electron Tubes); Erosion; Electric Arcs; Heat Transfer; Surface Properties; Work Functions; Adsorption

5143  
(DIAGNOSTICS AND INSTRUMENTATION)  
(E-field)  
AN AUTOMATIC ELECTRIC FIELD MEASURING EQUIPMENT OF VERY HIGH RESOLUTION AND ITS APPLICATION FOR THE STUDY OF ACUSTOELECTRIC PHENOMENA  
T. Zold  
McGill University, Montreal, Canada  
The Review Of Scientific Instruments, Vol. 44, No. 4, pp 488-414 (04/1973).  
An electric field measuring equipment with a capacitive probe of 40 micron resolution was constructed using only ordinary materials and techniques. The operation of this equipment was completely automatic and the electric field profiles were recorded continuously by an x-y recorder. The duration of one measurement, consisting typically of the recording of about 50 profiles and of the sample current vs time diagram, in 4 mm long samples, was approximately 50 min. The usefulness of this equipment has been proven through its use for the observation of a large number of new electric field domain formations in photoconducting CdS samples. The detailed description of these observations will be reported elsewhere. 16 Refs.  
Primary Keywords: Capacitive Probe; 40 Micron Resolution; Design Considerations; Operation Considerations  
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5154  
(ENERGY STORAGE, INDUCTIVE; ELECTROMAGNETIC FIELD GENERATION; SWITCHES, OPENING)  
(Systems; Magnetic; Superconductive)  
HIGH MAGNETIC FIELD PRODUCTION BY ELECTROMAGNETIC ENERGY STORAGE IN A SUPERCONDUCTING COIL  
A. Mainie (1), A. Fortini (1), M. Huissier (2) and M. Sauzade (2)  
(1) Universite de Caen, Caen, France  
(2) Faculte Des Sciences D'Orsay, Orsay, France  
Review Of Scientific Instruments, Vol. 43, No. 10, pp 1464-1467 (10/1973).  
A new method to produce high pulsed magnetic fields has been developed. Capacitors generally used for the storage of energy have been replaced by a superconducting coil which requires less space and lower operating cost. The choice for the different elements of the setup is discussed. A low energy model has produced a field of 20 teslas with a time constant of 15 msec.  
Primary Keywords: Magnetic Field Generation; Inductive Energy Store; Superconducting Coils; Superconducting Storage; Normal Opening Switch; Design Considerations; Low Energy Prototype  
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5156  
(SWITCHES, CLOSING)  
(Gas Gaps, Optical)  
TRIGGERING OF A PRESSURIZED SPARK GAP BY A LASER BEAM  
F. Deutsch  
CERN, Geneva, Switzerland  
Journal Of Physics D; British Journal Of Applied Physics, Vol. 1, pp 1711-1719 (03/1968).  
A delay line was discharged into a terminating resistor by a spark gap of coaxial design. The spark gap was triggered by a focussed laser beam, introduced along the axis: a Q-switched ruby laser giving pulses of 20 ns duration and up to 50 MW power was used. The range of operation of the gap, formative time of the breakdown and jitter were investigated for different gases at pressures above atmospheric, gap widths of 4-10 mm and voltages of up to 120 kv. Mixtures of argon and nitrogen were found to have certain advantages, such as a low threshold for ionization by the laser beam, sufficient dielectric strength, low values of the formative-time jitter and chemical inertness. Formative times of down to about 1 ns and jitters below 1 ns were found. The laser power can be relatively low (0.5-5 MW). An explanation for the breakdown mechanism is proposed. 5 Refs.  
Primary Keywords: Ruby Laser; Coaxial Spark Gap; Jitter Measurement; Delay Measurement; High Gap Pressure; Breakdown Mechanism  
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5158  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
A PRECISION MEGOHM RATIO UNIT FOR HIGH VOLTAGE MEASUREMENTS  
J.N. Harris  
California Institute of Technology, Pasadena, CA  
Review Of Scientific Instruments, Vol. 23, No. 8, pp 409-413 (08/1952).  
A precision megohm ratio unit consisting of 100 resistance units wound of manganin wire is described. Stability of the order of a few parts per million is achieved through careful construction. Variations due to temperature changes are reduced by operating the resistor in a circulating oil bath maintained at a temperature of 33 deg.C, where the temperature coefficient of the resistor is essentially zero. The resistor is capable of continuous operation at a potential of 5 kV and intermittent operation to 25 kV. A general method is also reviewed for setting up accurate resistance ratios by comparing two groups of resistors in appropriate series and parallel arrangements. Employing this method and using the units of the described megohm ratio unit, high ratios, consistently accurate to one part per million, have been set up. 6 Refs.  
Primary Keywords: DC Voltage Measurement; Modular Construction; High Precision; Medium Voltage  
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5161  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
ANALYSIS OF TRANSMISSION-LINE ACCELERATOR CONCEPTS  
J.K. Temperley and D. Eccleshall  
Army Amament Research and Development Command, Aberdeen Proving Ground, MD 21005  
Final rept. Nov 76-Sep 77 No. ARBRL-TR-02067, 58p (05/1978).  
Availability: AD-A056 364/3ST  
NTIS  
An analysis is presented of charged transmission-line configurations for use in high-current accelerators. Basic drawbacks of the symmetric radial-pulse-line design are identified. The concept of using asymmetric pairs of transmission lines of various geometries is introduced. Conditions for maximum efficiency and maximum energy transfer to the beam load are derived for ideal constant-impedance lines. It is shown that, in the lossless-line approximation, asymmetric line configurations exist with which both a high accelerating voltage per stage and nominal unit efficiency can be achieved. A recirculating accelerator is described, in which advantage is taken of a repetitive voltage waveform present in the transmission-line cavities to repeatedly accelerate a current pulse which is recirculated through the accelerator. Expressions for the open-circuit output voltage, accelerating voltage per stage, and efficiency of energy transfer to the beam are derived for this case also. It is shown that, with proper choice of parameters, this type of design again affords the possibility of nominal unit efficiency for energy transfer to the beam. (Author)  
Primary Keywords: Electron Accelerators; Transmission Lines; Electron Beams; Pulses; Energy Transfer; High Power; Voltage; Efficiency; Recirculation; Physics Laboratories; Army Research Laboratories  
Secondary Keywords: Aurora Facility; NTISDODXA

5162  
(PULSE GENERATORS)  
(Capacitive)  
BIG OPTICAL SPARK CHAMBERS AND PULSE GENERATORS FOR THEIR SUPPLYING  
A.F. Grushin, A.I. Egorov, L.K. Lythin, A.F. Pisarev and V.F. Pisarev  
Joint Inst. for Nuclear Research, Dubna (USSR).  
(01/1976).  
Availability: JINR-R-13-9745  
NTIS  
The construction is described and main operating characteristics are presented for big optical spark chambers with the gap of 2 cm, used in particle beams from accelerators. The working substance on the path of particles in the chambers is small and the chambers are of high shaver efficiency. The characteristics of high-voltage pulse generators, feeding these chambers, are presented. (Atomindex citat on 09:35836).  
Primary Keywords: High-voltage Pulse Generators; Spark Chambers; Aluminum; Design; Diagrams; Efficiency; Electrodes; Fabrication; Foils; Spark Gaps; Specifications  
Secondary Keywords: ERDA/440104; NTIS/NTIS Microfiche Only  
Distribution Restriction: U.S. SALES ONLY.

5144  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
CALIBRATION OF HIGH-VOLTAGE PULSE MEASUREMENT SYSTEMS BASED ON THE KERR EFFECT

R.E.J.M.M. Hebrer  
Sandia Labs, Albuquerque, NM 87115  
Final rept. Jul 75-Oct 77 No. NBSIR-77-1317, 39p (09/1977).  
Availability: PB-274 333/45T  
NTIS

High voltage pulse measurements have been performed using systems based on the electrooptic Kerr effect for a number of years. These systems permit state-of-the-art measurements (uncertainties approximately equal to  $\pm 1\%$ ). Because the precision of the measurement can be significantly better than the accuracy, an investigation of techniques to improve the calibration of the system was undertaken. The investigation focused on two areas. One was the experimental determination of correction factors which would account for differences in environmental factors between the calibration of the system and its use. These measurements yielded accurate corrections for variations in temperature and quantitative evidence of the magnitude of the wavelength dependence of a Kerr system's response. The second was further study into the feasibility of calibrating the Kerr system at a number of discrete frequencies and using this calibration for pulse measurement.

Primary Keywords: Kerr Cells; Electrical Measurement; Pulsation; High Voltage; Calibration; Kerr Electrooptical Effect; Nitrobenzenes; Space Charge  
Secondary Keywords: NTISCONPNS

5167  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
POSTULATION OF THE ARC RESTRIKE MECHANISMS FOR EXPLODING WIRES AND TUBES  
D.Y. Chen, M.J. Loubsky and V.E. Fousek  
University of Santa Clara, Santa Clara, CA 95053  
The Physics of Fluids, Vol. 14, No. 11, pp 2328-2334 (11/1971).

The many facets of exploding wire restrikes are studied. They are related to the cylindrical shock wave which pumps down the density of the center region of a line energy source or around the surface of the heated wire continuously to a lower density. When the density of any region is pumped down to lower than Paschen's electric breakdown criteria, restrike occurs. The cylindrical shocks occurring in exploding wires are, in general divided into two types. In the first type the shock is generated by wire explosion and in the second type the shock is generated by the heat conduction of the wire to the surrounding gas. Application of this mechanism to exploding tubes will enable us to create arc channels in arbitrary gaseous atmospheres with controllable plasma density with the contamination excluded. Neutral density shielded plasma experiments, therefore, can be conducted in a controllable environment. 14 Refs.

Primary Keywords: Exploding Wire; Exploding Tube; Arc Restrike; Cylindrical Shock Wave  
Secondary Keywords: Vapor Density Calculation; Thermal Conduction  
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5170  
(PARTICLE BEAMS, ION; PARTICLE BEAMS, NEUTRAL)  
(Generation; Generation)  
DESIGN PHILOSOPHY AND USE OF HIGH VOLTAGE POWER SYSTEMS FOR MULTI-MEGAWATT ION BEAM ACCELERATORS  
G.C. Barber, A.Y. Braverman, R.E. Hill, C.M. Loring and M.S. Ponte  
Oak Ridge National Lab, Oak Ridge, TN 37830  
Availability: CONF-771829-68  
NTIS

The requirements for a neutral beam high voltage power system are derived from the characteristics of the ion source. High voltage system component characteristic requirements and choices are described. (ERA citation 03:016278)

Primary Keywords: Neutral Beam Sources; Power Supplies; Beam Injection Heating; Design; Ion Sources; Plasma Heating; Recommendations; Specifications  
Secondary Keywords: ERDA/700205; NTISDE

5177  
HIGH-VOLTAGE TEST STAND AT LIVERMORE

M.E. Smith  
Lawrence Livermore Lab, Livermore, CA 94550  
No. CONF-771029-78, 7p (10/1977).  
Availability: UCRL-79614  
NTIS

This paper describes the present design and future capability of the high-voltage test stand for neutral-beam sources at Lawrence Livermore Laboratory. The stand's immediate use will be for testing the full-scale sources (120 kV, 65 A) for the Tokamak Fusion Test Reactor. It will then be used to test parts of the sustaining source system (80 kV, 85 A) being designed for the Magnetic Fusion Test Facility. Following that will be an intensive effort to develop beams of up to 200 kV at 20 A by accelerating negative ions. The design of the test stand features a 5-MVA power supply feeding a vacuum tetrode that is used as a switch and regulator. The 500-kW arc supply and the 100-kW filament supply for the neutral-beam source are battery powered, thus eliminating one or two costly isolation transformers. (ERA citation 03:016277)

Primary Keywords: Neutral Beam Sources; Test Facilities; Design; Electronic Circuits; Performance; Power Supplies; Test Device  
Secondary Keywords: ERDA/700205; NTISDE

5179  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
INVESTIGATION OF A HIGH VOLTAGE HOLLOW CATHODE ELECTRON BEAM SOURCE  
J. Hansen  
Risoe National Lab., Roskilde (Denmark).  
(04/1977).  
Availability: RISO-359  
NTIS

An investigation is presented of the possibility of developing an electron accelerator comprising several radiation units with a relatively low power per unit, and without the many elements such as accelerator tube, focusing and scanning systems. A study was desired of an electron gun operated at 200 kV based on the cold, hollow-cathode principle, where problems concentrated on the design of an electrode configuration that could withstand the high voltage at a pressure where a plasma could be generated too. Studies concentrated on the high voltage breakdown criterion in the pressure range  $10 \exp -3$  to  $10 \exp -2$  torr and on the plasma formation in a low pressure gas discharge. Controlled beams with energies up to 130 keV were generated in nitrogen at a pressure of  $2 \times 10 \exp -3$  torr with a beam current of about 1 mA in a continuous operation. The high voltage was limited by the existing power supply in the laboratory; however, a decision was taken not to purchase a power supply that could have delivered the required voltage. (Atomindex citation 08:343720)

Primary Keywords: Electron Sources; Breakdown; Cold Cathode Tubes; Electric Potential; Electron Beams; Electron Guns; Feasibility Studies; Glow Discharges; Hollow Cathodes; Key Range 10-100; Medium Vacuum; Paschen Law; Plasma Instability  
Secondary Keywords: ERDA/430100; Denmark; NTISNHS  
Distribution Restriction: AVAILABLE IN MICROFICHE ONLY. U.S. SALES ONLY.

5180  
(BREAKDOWN STUDIES)  
(Liquid; Electric)  
INVESTIGATIONS ON BREAKDOWN EVENTS IN LIQUID NITROGEN AT HIGH VOLTAGES  
D. Peier  
Technische Univ. Brunswick (West Germany). Fakultät fuer Maschiner und Elektrotechnik.  
(06/1975).  
Availability: NP-22472  
NTIS

The breakdown of liquid nitrogen was investigated using dc, a impulse voltages up to 200 kV. The electrode arrangement varied point-to-plane electrodes with point radii of 40  $\mu$ m to electro with nearly homogeneous fields. Electrode material and surface roughness were taken into account. The prebreakdown events were studied by the charge of the electrode, the breakdown itself by measuring the voltage and the current. Some types of instable predischarges were detected, but no stable ones. The immediate following breakdown occurred within 20 ns. The breakdown field strength depends on the gap distance s and the electrode radius. There is a minimum field strength due to the ratio of  $s/r = 5$  to 10. At a gap distance of 1 mm breakdown voltages of 50 kV were measured at ac and dc under atmospheric pressure (homogeneous field). This value is influenced by the surface roughness and the heat flux into LN sub 2. Electrode material is only of little influence. Based on these measurements some aspects of a breakdown mechanism are pointed out: electrons, generated by field emission, may cause microbubbling in front of microtips on the surface. The microbubbles may be the starting point for ionization processes and avalanches, leading to a breakdown channel. The channel build up is similar to the streamer and leader mechanism, observed in long air gaps. (ERA citation 03:008313)

Primary Keywords: Cryogenic Cables; Nitrogen; Breakdown; Cryogenic Fluids; Data; Dielectric Materials; Env Ac Systems; Env Dc Systems; Performance Testing  
Secondary Keywords: ERDA/200303; ERDA/420201; West Germany; Dielectric Breakdown; Liquid Nitrogen; High Voltage; NTISDEE  
Distribution Restriction: U.S. Sales Only.

5181  
(PULSE GENERATORS)  
(Trigger)  
LIMITING CONDITIONS IN A FERRORESONANT TRIGGER CIRCUIT

J.G. SKALNIK  
Yale Univ New Haven Conn Dunham Lab  
(10/1955).  
Availability: AD-079 851/25T  
NTIS

No abstract available.  
Primary Keywords: Trigger Circuits; Circuits; Mathematical Analysis  
Secondary Keywords: NTISDODXD  
Distribution Restriction: DISTRIBUTION LIMITATION NOW REMOVED. NOTE: ONLY 35MM MICROFILM IS AVAILABLE. NO MICROFICHE.

5184  
OPTICALLY COUPLED HIGH VOLTAGE ISOLATION AMPLIFIER

J.W. Pearce  
Oak Ridge National Lab, Oak Ridge, TN 37830  
Availability: ORNL/TM-6207  
NTIS

A common and persistent problem in modern instrumentation is the observation and recording of small signal waveforms that are removed from ground by very high voltages. Examples of this are the instrumentation of neutral particle injectors used in controlled thermonuclear research and the construction of safety breaks for air core toroidal devices. To overcome this problem a very high voltage isolation amplifier was designed. It employs analog-to-digital conversion with serial data transmission on a fiber optic cable. (ERA citation 03:032477)

Primary Keywords: Measuring Instruments; Neutral Beam Sources; Amplifiers; Analog-to-digital Converters; Construction; Design; Neutral Atom Beam Injection; Thermonuclear Reactors  
Secondary Keywords: ERDA/700209; ERDA/700205; Isolation; High Voltage; Fiber Optics Transmission Lines; NTISDE

5185  
(POWER CONDITIONING)  
(Saturable Reactors)  
POSSIBILITY OF USING MAGNETIC PULSE GENERATORS IN LINEAR INDUCTION  
ACCELERATORS

R.V. Khar'yuzov and V.A. Shvets  
Joint Inst. for Nuclear Research, Dubna (USSR).  
(01/1976).  
Availability: JINR-9-9523

NTIS  
Results of an experimental study of pulse magnetic generators for the LIU-30 pulsed linear accelerator are given. The pulse magnetic generator is essentially a forming line including capacitors and iron-core chokes. Two types of generators are described: generators of the first type are energized from an ac source and have no controlled switches, while those of the second type are energized from a dc source and contain controlled switches. Advantages of generators of the second type are shown. Circuits of generators of the second type for 18 and 24 kW are given. Experiments aimed at producing a nanosecond front in generator pulses indicate that in the case of high-quality permalloy or permendur being used as the material of the choke cores, a pulse with a front of 50 to 60 ns at an amplitude of up to 100 A can be obtained. To provide the front of less than 10 exp - exp 8 s, in the last two stages use should be made of low-inductance capacitors with an intrinsic inductance of no more than a few nH. The results of the study show that pulse magnetic generators operate stably with a load of 500 to 1,000 Ohm. At this load the current front is 5 to 6 ns. (Atomindex citation 09:363273)

Primary Keywords: Accelerators; High-voltage Pulse Generators; Capacitors; Diagrams; Electric Coils; Frequency Dependence; Induction; Performance; Permalloy; Pulse Rise Time; Pulse Shapers; Reliability; Specifications; Thyristors  
Secondary Keywords: ERDA/30303; USSR; NTIS  
Distribution Restriction: AVAILABLE IN MICROFICHE ONLY. U.S. SALES ONLY.

5186  
(PARTICLE BEAMS, NEUTRAL)  
(Generation)  
PRESENT AND FUTURE TECHNOLOGY OF HIGH VOLTAGE SYSTEMS FOR NEUTRAL BEAM  
INJECTIONS

M.R. Baker and D.B. Hopkins  
Lawrence Berkeley Lab, Berkeley CA  
No. CONF-771213-8, 36p (01/1978).  
Availability: LBL-7261

NTIS  
This paper presents: (1) A brief review of existing neutral beam (NB) power supply technology for operating up to approximately 200 kV, 65 A; (2) Possibilities for using existing systems for next-generation NB sources, and associated problems; (3) A summary of the features of present systems which contribute to a high degree of complexity and/or cost; (4) A plea and proposal for minimizing cost and complexity of future systems operating up to approximately 300 kV; (5) A few comments pertaining to special problems associated with operating in the 300 to 1000-kV range; and (6) A listing of some specific task areas which we believe should receive early R and D effort. (ERA citation 03:032415)

Primary Keywords: Neutral Beam Sources; Power Supplies; Cost; Research Programs; Reviews; Thermonuclear Reactors  
Secondary Keywords: ERDA/700203; ERDA/700205; Neutral Atomic Beam Injection; NTISDI

5189  
(ENERGY CONVERSION, MECHANICAL)  
(Charging Circuits)  
PULSE CHARGING OF NANOFARAD CAPACITORS TO TENS OF KILOVOLTS FROM THE  
SHOCK DEPOLING OF PZT FERROELECTRIC CRYSTALS

M.J.H.M.M. Mock  
Naval Surface Weapons Center, Dahlgren, VA 22448  
Final rept. No. NSWC-DL-TR-3804, 74p (04/1978).  
Availability: AD-A058 607/35T

NTIS  
Gas gun impact techniques have been used to pulse charge nanofarad capacitors from the shock depoling of PZT 56/44 and PZT 95/5 ferroelectric ceramics. The PZT materials were depoled in the normal mode. Pulse powers of hundreds of kilowatts were produced in a few microseconds. The PZT 56/44 material was impacted in the stress range from 4.4 to 11.8 GPa. A maximum load voltage of 35 kV was produced at 7.9 GPa. Shock-induced electrical breakdown in the PZT material occurred at 11.8 GPa. The PZT 95/5 material was impacted at 1.4 and 2.9 GPa at stress levels. A maximum load voltage of 81 kV was produced at the higher stress. (Author)

Primary Keywords: Pulse Generators; Shock Waves; Ferroelectric Crystals; Breakdown (Electronic Threshold); Dielectric Properties; High Energy; High Voltage; Electrical Loads; Zirconates; Titanates  
Secondary Keywords: Capacitor Chargers; NTISDDOXA

5190  
(PULSE GENERATORS)  
(Capacitor Banks)  
PULSE MODULATOR FOR AN EXPERIMENTAL ELECTRON GUN

P.S. Antsupov, I.M. Motova and V.A. Shvets  
Joint Inst. for Nuclear Research, Dubna (USSR).  
(01/1975).  
Availability: JINR-13-9277

NTIS  
The construction features are described and the main diagram is presented for a pulse modulator with an output power up to 150 MW, potential of 60 kV, and pulse current of 2500 A. A capacitive energy accumulator with particle discharge and output pulse transformer are used in the modulator. An advantage of the modulator is the absence of high-energy forming lines. The modulator consists of three main units: a thyristor startup device, thyristron sub-modulator, and modulator with stable tubes. There is also a series of charging devices, a water-cooling system, and a system of locking, control, and signal units. The main feature of the modulator is the absence of a constant potential on the screening grids of the modulator tubes; the modulator tubes are started up simultaneously through two grids--the control and the screen. The tubes are cooled by water forced from the water-distillation unit with 4.5 atm pressure. The modulator has operated dependably for 4 years and has shown highly constant parameters for the output pulse and reliability in operation. (Atomindex citation 09:360709)

Primary Keywords: Electron Guns; Control Systems; Cooling; Diagrams; Medium Pressure; Modulators; Pulse Shapers; Pulses; Thyristons; Thyristors; Transformers; Trigger Circuits  
Secondary Keywords: ERDA/430200; USSR; NTISINIS  
Distribution Restriction: U.S. SALES ONLY

5191  
(POWER CONDITIONING)  
(Pulse Transformers)  
PULSE TRANSFORMER DESIGN STUDY

H. Alin  
Physic International Co. San Leandro, CA 94577  
Final rept. Dec 75-Mar 77 No. PIFR-897, 79p (11/1977).  
Availability: AD-A047 499/95T

NTIS  
This final report describes the design, development of fabrication techniques, fabrication, and testing of two uniform field, air core pulse transformers. The described transformer design minimizes the volume of dielectric material, which provides turn-to-turn insulation, reduces stray series inductance, and thus improves the transformer high frequency response in comparison to conventional pulse transformers. The described pulse transformers are intended for repetitive pulse operation with output voltages of about 200 kV into matched resistive loads. Output pulse width and risetimes are about 10 microsec and 1 microsec (10 to 90 percent) respectively. (Author)

Primary Keywords: Pulse Transformers; Solenoids; Electric Coils; Fabrication; Inductance; Frequency Response; Dielectrics; Pulse Trains; Electric Fields; Insulation; Lightweight  
Secondary Keywords: Air Cores; Dielectric Constant; NTISDDOXA

5192  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
REB FOCUSING IN A HIGH-VOLTAGE DIODE

I.P. Afonin, M.V. Babushin and B.V. Beav  
KAE Atomic Energy Institute, Moscow, USSR  
(02/1978).  
Availability: SAND-78-6005

NTIS  
Experimental data on the focusing of an intense relativistic electron beam on the "Angara-1" and "Kalmir-1" accelerators are reported. The use of these accelerators to simulate conditions in a controlled thermonuclear reactor with inertial plasma confinement is discussed. (ERA citation 03:033593)

Primary Keywords: Accelerators; Thermonuclear Reactors; Electron Beams; Focusing; Foils; Heating; Plasma Confinement; Relativistic Range  
Secondary Keywords: ERDA/430200; ERDA/700208; Translations; USSR; NTISDET  
Distribution Restriction: TRANSLATION BY P. NEWMAN OF ISSLEDOVANIYE FOKUSIROVKI REP V VYSOKOVOL'TNOM DIODE.

5193  
REPETITIVE SERIES INTERRUPTER II

R.F. Caristi, R.P. Simon and D.V. Turnquist  
EG&G Inc, Salem, MA 01970  
Interim rept. no. 7, 1 Oct 77-31 Jan 78 (06/1978).  
Availability: AD-A055 999/75T

NTIS  
The interruption characteristics have been established for six developmental 'plasma chute' interrupters, five rated at 15 kV and one rated at 30 kV. Six-hundred ampere interruptions at 20 kV have been achieved with a magnetic field energy of less than 8 joules. The most efficient interaction channel geometry has been found to be one which contains both a 'chuted' surface against which the discharge is magnetically driven, and an unchuted (smooth) surface located behind the driven discharge. The presence of which latter surface minimizes the availability of plasma to sustain the discharge. Typical interaction column drops have been found to be 300 to 400 volts per section (20 to 26 volts/cm) at reasonable tube pressures with no more than three (and possibly two) sections being adequate for the operation of tubes rated at 50 kV. Holdoff-section voltage drops of about 120 volts have been observed for holdoff sections capable of withstanding 30 kV. A total tube drop of 830 volts has been observed at the 25 kV, 18.5 A level. Linear extrapolation of existing data to the 50 kV, 1000 A level shows that reliable interruption should be achievable with a magnetic field energy of the order of 10 joules for an interrupter having a total tube drop of about 1200 volts, or 2.4% of the system's operating voltage. (Author)

Primary Keywords: Interrupters; Thyristors; Switching Circuits; Plasmas (Physical); Magnetic Fields; Gas Discharges; Trigger Circuits; Electric Discharges; Protective Equipment; Energy; Pulse Generators  
Secondary Keywords: Hydrogen Thyristors; NTISDDOXA

5195  
(BREAKDOWN STUDIES)  
(Gas, E-beam)  
SMALL SCALE DISCHARGE STUDIES

M. Rohm, J.H. Jacob and J.A. Mangano  
Avco Everett Research Lab, Inc, Everett, MA 02149  
Semi-annual rept. 1 Sep 76-28 Feb 77 (02/1977).  
Availability: AD-A047 221/75T

NTIS  
The dominant formation and quenching processes in e-beam pumped ArF<sub>2</sub> and KrF<sub>2</sub> lasers are discussed. The exciplexes are produced by irradiating Ar/F<sub>2</sub> and Ar/Kr/F<sub>2</sub> mixtures with a 5 A/cm<sup>2</sup>, 150 keV e-beam. A steady state analysis is valid since the reaction times are short compared to the 300 nsec beam pulse length. The quenching of ArF<sub>2</sub> by F<sub>2</sub> and Ar has been measured by analyzing the ArF<sub>2</sub> fluorescence as a function of the F<sub>2</sub> and Ar partial pressures. We have also measured the displacement of the Ar in ArF<sub>2</sub> by Kr to form KrF<sub>2</sub>. The dominant quenching processes of KrF<sub>2</sub> were identified and the rate constants were measured. The ArF<sub>2</sub> and KrF<sub>2</sub> are formed from the ionic states with high efficiency. Interception of the precursors can be made negligible by choosing the experimental conditions properly. The quenching of KrF<sub>2</sub> by Ar and Kr is mainly a three body process resulting in the formation of Kr<sub>2</sub>F<sub>4</sub>. The emission from Kr<sub>2</sub>F<sub>4</sub> was observed in a broad band centered at 410 nm. We have verified that the Kr<sub>2</sub>F<sub>4</sub> is produced subsequent to the KrF<sub>2</sub> formation by performing a laser saturation experiment.

Primary Keywords: Ultraviolet Lasers; Gas Lasers; Rare Gases; Fluorides; Argon Lasers; Electron Beams; Krypton; Gas Discharges; High Voltage; Fluorescence; Quenching  
Secondary Keywords: Krypton Fluoride Lasers; Argon Fluoride Lasers; Electrical Lasers; Reaction Kinetics; NTISDDOXA

5196  
(SWITCHES, CLOSING)  
(Gas Gaps, Materials)  
SPARK GAP OVERPRESSURES IN THE TRANSFER CAPACITOR DEVICE  
L.C. Burkhardt and R.S. Dike  
Los Alamos National Labs, Los Alamos, NM 87545  
Mo. CONF-771029-29, 4p (01/1977).  
Availability: LA-UR-77-2417  
NTIS

A designer of spark gaps is often faced with two gas pressure problems, one static and one dynamic. The former is easy to obtain data on which to base intelligent design specifications; about the latter, less is known. It is the total internal pressure environment we have attempted to measure, in an un-time-resolved way, in order to give the designer some rationale in designing gaps of this category. We measure overpressures of approximately 400 PSI in a 13 cubic inch gap passing currents of approximately 200 kA. (ERA citation 03:020701)  
Primary Keywords: Power Supplies; Spark Gaps; Breakdown; Capacitors; Electrodes; Failures; Medium Pressure; Switches; Thermo-nuclear Devices  
Secondary Keywords: ERDA/700203; NTISDE

5197  
(POWER CONDITIONING; PULSE GENERATORS)  
(Pulse Transformers; Blumlein Lines)  
STREAMER CHAMBER POWER SUPPLY ON THE BASE OF A 500KV PULSE TRANSFORMER  
Y.V. Grishkevich, D. Pozo, K. Ryuger, K. Tryuchler and G. Peter  
Joint Inst. for Nuclear Research, Dubna (USSR).  
Availability: JINR-R-13-9366  
NTIS

Theory and constructional layout of a pulse transformer is given by which it is possible to drive a large Blumlein-line as a high-voltage pulse generator for a streamer chamber. The transformer is capable of generating voltage pulses with an amplitude of 500 kV at a load of 1000 ohms. The rise time of the pulse is 300 nsec. The stability of the pulse amplitude in the streamer chamber is  $\pm 1.5\%$  and the jitter of the pulse delay time is  $\pm 10$  nsec. (Atomindex citation 08:318990)

Primary Keywords: High-voltage Pulse Generators; Streamer Spark Chambers; Diagrams; Pressure Dependence; Pulse Shapers; Specifications; Surges; Transformers  
Secondary Keywords: ERDA/440164; USSR; NTISINIS  
Distribution Restriction: Available in microfiche only. U.S. Sales Only.

5198  
SUPER POWER GENERATORS

T.M. Martin, D.L. Johnson and D.W. McDaniel  
Sandia Labs, Albuquerque, NM 87115  
Mo. CONF-771035-5, 24p (01/1977).  
Availability: SAND-77-1324c  
NTIS  
PROTO II, a super power generator, is presently undergoing testing at Sandia Laboratories. It has operated with an 80 ns, 50 ns, 35 ns, and 20 ns positive output pulse high voltage mode and achieved total current rates of rise of  $4 \times 10^{10}$  exp 14 A/s. The two sided disk accelerator concept using two diodes has achieved voltages of 1.5 MV and currents of 4.5 MA providing a power exceeding 6 TW in the electron beam and 8 TW in the transmission lines. A new test bed named MITE (Magnetically Insulated Transmission Experiment) was designed and is now being tested. The pulse forming lines are back to back short pulse Blumleins which use untriggered water switching. Output data showing a ten ns half width power pulse peaking above one terawatt were obtained. MITE is a module being investigated for use in the Electron Beam Fusion Accelerator and will be used to test the effects of short pulse propagating down vacuum transmission lines. (ERA citation 03:008968)  
Primary Keywords: Accelerators; Power Transmission Lines; Design; Electron Beams; High-voltage Pulse Generators; Magnetic Shielding; Mega Amp Beam Currents; Operation; Performance Testing; Thermo-nuclear Reactors  
Secondary Keywords: ERDA/430300; ERDA/700208; NTISDE

5200  
(POWER CONDITIONING)  
(Pulse Transformers)  
THE THEORY OF THE OPTIMUM TRANSMISSION-LINE PULSE-TRANSFORMER  
F.J. Young  
Carnegie Mellon University, Pittsburgh PA 15213  
(10/1956)  
Availability: AD-114 090/457  
NTIS

No abstract available.  
Primary Keywords: Transmission Lines; Transients; Determination; Theory  
Secondary Keywords: Pulse Transformers; MITSDDXD  
Distribution Restriction: DISTRIBUTION LIMITATION NOW REMOVED. NOTE: ONLY 35MM MICROFILM IS AVAILABLE. NO MICROFICHE.

5201  
(PULSE GENERATORS)  
(Systems)  
TRIGGER AND CONTROL CIRCUITS FOR HIGH-VOLTAGE GENERATORS  
K. Ondre ke and L.K. Lytkin  
Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.  
(01/1977).  
Availability: JINR-R-13-10432  
NTIS

Fast trigger and control circuits have been designed for a system of high-voltage generators used for spark chamber supply. The trigger circuit has been constructed on the basis of the tube G1-30 and semiconductor transistors KT603B operating in a shaver regime. The control circuit has been constructed of internal circuits of TTL type. For a long time the scheme was tested on the magnet spark spectrometer of the JINR and was found to be highly reliable. (Atomindex citation 08:335382)  
Primary Keywords: High-voltage Pulse Generators; Spark Chambers; Control Systems; Diagrams; Integrated Circuits; Logic Circuits; Transistor Trigger Circuits  
Secondary Keywords: ERDA/440104; USSR; NTISINIS  
Distribution Restriction: AVAILABLE IN MICROFICHE ONLY. U.S. SALES ONLY

5203  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
USE OF A CORONA IN THE NEEDLE-PLANE SYSTEM AS A HIGH-VOLTAGE DIVIDER ELEMENT  
L.V. Smirnov, V.D. Mikhailov and R.S. Chachikov  
GKAE Atomic Energy Institute, Moscow, USSR  
(01/1975).  
Availability: NIIEFA-D-0246  
NTIS

Some characteristics are investigated of a corona discharge in a needle-surface system with a view to utilizing corona-discharging gaps as elements of a high-voltage divider. Results are cited for preliminary trials of a "corona divider" model. A comparative assessment is also given with regard to divider efficiency. (Atomindex citation 05:340870)  
Primary Keywords: Electrostatic Accelerators; Breakdown; Comparative Evaluations; Corona Discharges; Efficiency; Electric Potential; Medium Pressure; Nitrogen; Pressure Dependence  
Secondary Keywords: ERDA/430200; USSR; NTISINIS  
Distribution Restriction: AVAILABLE IN MICROFICHE ONLY. U.S. SALES ONLY.

5204  
(PARTICLE BEAMS, ELECTRON; SWITCHES, CLOSING; ENERGY STORAGE, CAPACITIVE)  
(Reviews; Reviews; Marx Generators)  
LASER-FUSION AND ELECTRON-BEAM-FUSION PROGRESS REPORT JULY-DECEMBER 1974  
Sandia Labs, Albuquerque, NM 87115  
Sandia Report No. SAND75-0262 (06/1975).  
Availability: SAND75-0262  
NTIS

This report provides an overview of the research conducted at Sandia Laboratories in July-December 1974. The laser fusion program is discussed with most attention placed on laser action in the laser medium and target interaction. The report on electron beam fusion is characterized by sections on energy storage, switching, transmission lines, and diode construction. Theoretical work on target design and plans for the future are included. 8 Refs.  
Primary Keywords: E-beam; Water Switch; Oil Switch; Gas Gap; Blumlein; Magnetic Insulation; Water Insulated Transmission Line  
Secondary Keywords: HF Laser; KrO Laser; Laser-target Interaction

5205  
(SWITCHES, OPENING; DIAGNOSTICS AND INSTRUMENTATION)  
(Explosives; Miscellaneous)  
MICROWAVE DOPPLER MEASUREMENTS OF THE IONIZATION FRONT IN CYLINDRICAL SHOCK WAVES FROM EXPLODING WIRES  
D.L. Jones and M. Gallet

National Bureau of Standards, Boulder, CO 80302  
Exploding Wires, Vol. 127-144 (01/1962).  
Strong cylindrical shock waves from exploding wires have been measured by microwave Doppler techniques. The results obtained simultaneously on two or three independent frequencies are in very good agreement and show that the ionization front is well defined. The Taylor-Lin similarity blast wave theory for the shock wave propagation is well verified over distances up to 6 or 7 cm under the present conditions. Systematic results for the determination of shock wave energy and the efficiency for shock production in air over a range of pressures, wire diameters, and stored electrical energy are presented. Relative to optical methods used in the same problem the present technique is more sensitive and perhaps more precise. It is remarkable that very good reflections are still consistently obtained when the shock Mach number falls below 3 in air. From the calculated temperature and ionization in the shock front, the expected electron density should then be negligible. This effect is probably a result of the pre-excitation of the gas ahead of the shock front, caused by ultraviolet radiation from the wire explosion or from the advancing shock front itself. There is also a relatively weak precursor, for which recent microwave absorption measurements have indicated electron densities of the order of  $10^{11}/\text{cm}^3$ , several cm. ahead of the front. The good reflection at low Mach numbers permits one to show that the similarity theory is still valid until Mach number 4 or below. 9 Refs.  
Primary Keywords: Exploding Wires; Shock Wave; Low Mach Numbers; Comparison With Optical Technique; Pre-excitation; Precursor Ionization  
COPYRIGHT: 1962 PLENUM PRESS

5206  
(SWITCHES, OPENING)  
(Explosive; Fuses)  
PRECURSOR ELECTRONS AHEAD OF CYLINDRICAL SHOCK WAVES  
D.L. Jones

National Bureau of Standards, Boulder, CO 80302  
The Physics of Fluids, Vol. 5, No. 9 pp 1121-1122 (09/1962).  
Microwave absorption techniques are used to study the ionization ahead of cylindrical shock waves produced by exploding wires. Before the front of the shock waves reaches the microwave beam, significant ionization occurs in the area. Possible explanations are discussed. The tests were done using a copper wire in air, argon, nitrogen, and helium. 8 Refs.  
Primary Keywords: Exploding Wires; Plasma Radiation; Cylindrical Shock Wave; Gas Pressure  
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5207  
(SWITCHES, CLOSING)  
(Gas Gaps, Optical)  
LASER TRIGGERED SPARK GAP USING FIBER OPTIC TRANSMISSION  
H.C. Harjes  
Texas Tech University, Lubbock, TX 79409  
LL Report No. UCLL 15202 (12/1979).  
Availability: UCLL 15202  
NTIS

The use of an optical fiber in a laser triggering system is described. The fiber transmits a high power ruby laser pulse which triggers a high voltage spark gap. The spark gap is a gas switch on a water dielectric Blumlein generator which is pulse charged by a three stage Marx bank. Typical operating parameters for the spark gap are: 2 cm gap, 2700 torr pressure, Ar-H<sub>2</sub> sub 2/ gas mixture, and a charging voltage of 200 kV. The single strand, 1 mm, quartz, optical fiber is selected specifically for high power transmission capability. Laser pulses of 4 MW are coupled into and transmitted by the fiber with no observed damage. The overall optical system transmission efficiency is 6%. The triggering performance of the system is excellent in that switching delays of less than 10 ns and subnanosecond jitter are measured. 11 Refs.  
Primary Keywords: Laser Triggering; Fiber Optic; Ruby Laser; Low Jitter

5268  
(PARTICLE BEAMS)  
(Reviews)  
DEVELOPMENTS IN SANDIA LABORATORIES PARTICLE BEAM FUSION PROGRAM  
G. Yonas and The Sandia Laboratories Particle Beam Fusion Group  
Sandia Labs, Albuquerque, NM 87115  
Seventh International Conference On Plasma Physics And Controlled  
Nuclear Fusion Research (08/1978).  
An overview of work being done by the Sandia Labs particle beam  
fusion group is presented. Developments in the areas of light ion  
drivers and targets specifically tailored for that type of beam are  
described. Overall requirements for the reactor itself are examined.  
21 Refs.  
Primary Keywords: High Energy; High Current; High Power  
Secondary Keywords: Fusion Reactor; Fusion Targets  
COPYRIGHT: 1977-1978

5233  
(BREAKDOWN STUDIES)  
(Partial Discharges)  
AN INFORMATIVE METHOD FOR RECORDING PARTIAL DISCHARGES IN INSULATING  
MATERIALS  
R.G. Johnson and S.J. Tibbatts  
Monsieyell Corporate Research Center, Bloomington, MN 55420  
The Review Of Scientific Instruments, Vol. 44, No. 4, pp 519-520  
(04/1973).  
A method of recording large numbers of partial discharge pulses  
graphically as a function of specimen voltage on a linear time base  
is described. The conventional method, using a Lissajous figure  
synchronized with the specimen voltage, does not show a graphic  
relation between the pulse occurrence and specimen voltage, and is  
limited by the repetitive nature of the Lissajous figure. Examples of  
the discharge pulse patterns obtained with the new method are given  
to illustrate the versatility of the technique. The method provides  
useful information in the study of partial discharge characteristics  
and causes. 1 Refs.  
Primary Keywords: Partial Discharge; Several Discharges; Automated  
System; Specimen Voltage Recording  
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PERMISSION

5236  
(INSULATION, MATERIAL)  
(Gas)  
COMPRESSED GAS INSULATION IN THE MILLION-VOLT RANGE: A COMPARISON OF  
SF<sub>6</sub>/SUB 6/ WITH N<sub>2</sub>/SUB 2/ AND CO<sub>2</sub>/SUB 2/  
S.F. Philp  
Massachusetts Institute of Technology, Cambridge, MA  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-82, No. 3,  
pp 356-359 (06/1963).  
Maximum voltage which can be insulated between a sphere and a  
plane has been measured as a function of gas pressure and gap. It is  
found to be approximately three times higher in SF<sub>6</sub>/SUB 6/ than in  
N<sub>2</sub>/SUB 2/ + CO<sub>2</sub>/SUB 2/, up to pressures of roughly 9 atm. For higher  
pressures the relative superiority of SF<sub>6</sub>/SUB 6/ over N<sub>2</sub>/SUB 2/ +  
CO<sub>2</sub>/SUB 2/ diminishes. Gradients of more than 100 MV/m were insulated  
on a 19-mm-diameter electrode in 20 atm of SF<sub>6</sub>/SUB 6/. 26 Refs.  
Primary Keywords: Sphere-plane Gap; Several Gases; Variable Gas  
Pressure; Variable Gap Spacing  
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5249  
(INSULATION, MATERIAL)  
(Gas)  
FLUOROCARBON GASES  
J.T. Milak  
Hughes Aircraft Co, Culver City, CA 90230  
Data sheets No. ds-142, 2p (11/1964).  
Availability: AD-608 897  
NTIS  
A compilation of the electrical properties of various halocarbon  
or halogenated hydrocarbons known as Freons, Genetrans, Arctons,  
etc., is presented. A master identification chart relating the  
trade names and numbers to the chemical name is included for easy  
reference. Detailed electrical properties include Corona effects,  
dielectric constant, dielectric strength and dissipation factor. Each  
property is compiled over the widest possible range of pressure,  
temperature, electrode geometry effects and types of electrodes from  
references obtained in a thorough literature search. Physical and  
chemical property data are also included as well as electrical and  
electronic applications. (Author)  
Primary Keywords: HALOGENATED HYDROCARBONS ELECTRICAL PROPERTIES;  
FLUORINE COMPOUNDS ELECTRICAL PROPERTIES; ELECTRICAL  
PROPERTIES HALOGENATED HYDROCARBONS; GASES;  
DIELECTRIC; FLUOROCARBON; BROMINE COMPOUNDS;  
FLUORIDES; ALIPHATIC COMPOUNDS; ELECTRICAL CORONA;  
DATA  
Secondary Keywords: FLUOROCARBONS

5255  
(SWITCHES, CLOSING)  
(Gas Gaps, Optical)  
INVESTIGATION OF A LASER TRIGGERED SPARK GAP  
W.K. Pendleton (1) and A.H. Guenther (2)  
(1) AFIT, Wright-Patterson AFB, OH  
(2) AFML, Kirtland AFB, NM 87117  
The Review Of Scientific Instruments, Vol. 36, No. 11, pp 1546-1550  
(11/1965).  
The influence of parameters affecting the laser triggering of a  
high voltage electrical sphere-sphere gap has been experimentally  
investigated. Of primary interest was the delay time between arrival  
of the laser pulse and current flow across the gap. This delay was  
studied as a function of total laser beam power (0-80 MW); dielectric  
gas (SF<sub>6</sub>/SUB 6/, W/sub 2/, air); gas pressure (100-1400 Torr);  
electrode spacing (0.4-1.5 cm); gap electric field (10-100 kV/cm);  
and focus point location between two 5 cm d. stainless steel  
spheres. Delay times less than 10 nsec were observed in SF<sub>6</sub>/SUB 6/ at  
atmospheric pressure with corresponding low jitter. For the cases  
studied delay times varied inversely with the electric field, gas  
pressure and focus point distance from the anode surface. Above a  
certain laser beam power the delay time was not a significant  
function of laser power for the range studied. Applications of laser  
triggering are discussed with a description of current and future  
research areas. 12 Refs.  
Primary Keywords: Delay Measurement; Sphere-sphere Gap; Several Gases;  
Variable Pressure; Variable Spacing; Variable Voltage  
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PERMISSION

5260  
NANOSECOND SWITCH DEVELOPMENT  
J.M. Proud and P. Felsenthal  
Space Sciences Inc, Waltham, MA  
Technical rept. 1 Jun 64-1 Apr 65 No. 551-229-FR, 156p (11/1965).  
Availability: AD-674 653/357  
NTIS  
A program to develop a switch or switch technique suitable for use  
in a stripline voltage multiplication circuit is reported. Switch  
requirements include rise time and jitter of less than 5 nsec,  
inductance in the low nanohenry range, as well as simplicity,  
reliability and ease of maintenance. Two major tasks were the design  
and development of a high pressure gas switch aimed at meeting the  
above requirements and the obtaining of sufficient fundamental  
breakdown data in liquid and solid dielectrics to show their  
feasibility as a nanosecond switching medium. A comprehensive switch  
literature search and the bibliography included here show that no  
existing switches meet program requirements. (Author)  
Primary Keywords: Pressure Switches; Electric Switches; Dielectric  
Films; Dielectrics; Solids; Liquids; Pulse  
Generators; Gas Discharges; Electric Discharges;  
Reliability(Electronics); Abstracts; Halogenated  
Hydrocarbons; Halocarbon; Plastics; Hydrocarbons  
Secondary Keywords: Nanosecond Switch; Stripline Circuits; NTISDCDXD  
Distribution Restriction: DISTRIBUTION LIMITATION NOW REMOVED.

5277  
(SWITCHES, CLOSING; SWITCHES, CLOSING)  
(Gas Gaps, Electrical; Liquid Gaps, Electrical)  
THE ADVANCED DEVELOPMENT OF WATER TRIGATRON AND THREE-ELECTRODE SULFUR  
HEXAFUORIDE SWITCHES  
T. Fleischman and I. Smith  
Physic International Co, San Leandro, CA 94577  
Physic International Report No. PIFR-114 (01/1970).  
Availability: AD 707407  
NTIS  
In this report, the performances of a water trigatron and a field  
distortion gas gap are compared. Voltage of interest ranged from 300  
kV to 1 MV with jitters of 1 ns or less desirable. The gas switch is  
an SF<sub>6</sub>/SUB 6/ filled spark gap with both a knife edge and fine wire  
used as a trigger. Since the switch was designed to operate in a  
water filled line, the water trigatron was at first thought to  
provide the most promising, but subsequent tests proved that the gas  
switch had much less delay and jitter. The design philosophy is  
analyzed for each switch with several design tips presented. 8 Refs.  
Primary Keywords: Water Trigatron; SF<sub>6</sub>/SUB 6/ Field Distortion Gap;  
Performance Tests; Design Considerations;  
Transmission Line

5294  
(BREAKDOWN STUDIES)  
(Gas, Optical)  
IONIZATION EFFECTS IN A HYDRODYNAMIC MODEL OF RADIATION-DRIVEN  
BREAKDOWN WAVE PROPAGATION  
M.H. Kay  
Queen's University of Belfast  
Journal Of Physics B:Atom, Molec. Phys., Ser. 2, Vol. 2, pp 544-550  
(05/1969)  
An extension of the hydrodynamic theory of radiation-driven  
breakdown was proposed in which ionization is  
treated explicitly in the conservation equations. A cubic equation  
relating the instantaneous velocity to the absorbed laser flux  
density is obtained. This reduces to the result obtained by Ramsden  
and Sevic in 1964 and Reizer in 1965 if ionization energies are  
neglected. Calculated results from the present theory are compared  
with those obtained by neglecting ionization. For the regime of  
interest in laser-induced breakdown of gases, the effects of  
ionization are seen to be significant. 10 Refs.  
Primary Keywords: Laser Driven Breakdown; Breakdown Wave; Theory;  
Hydrodynamic Theory; Conservation Equation;  
Laser Flux Relationship  
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5295  
(PULSE GENERATORS; SWITCHES, CLOSING)  
(Line Type: Gas Gaps, Electrical)  
MULTIMEGAVOLT MODULATOR STUDY  
J.J. Moriarty, H.I. Milde and J.E. Hipple  
Ion Physics Corp, Burlington, MA 01803  
Final technical rept. 60-4 Mar 70 (08/1970).  
Availability: AD-875 259/657  
NTIS  
Energy storage and switching systems related to modulator  
operation at voltages in excess of one million volts are discussed.  
Two basic switch-closure schemes are treated in detail: the trigatron  
and the laser-triggered switch. Experimental determinations of  
multimegavolt switching range and spark gap erosion are described.  
Test results are presented for a high voltage pulse generator which  
can be controlled from ground potential by means of optical  
telemetry. A 1-MV prototype of a high average power, high voltage  
power supply developed at the High Voltage Engineering Corporation is  
described. (Author)  
Primary Keywords: Modulators; Pulse Generators; Electronic Switches;  
Trigger Circuits; Lasers; Radar Equipment; Voltage;  
Power Supplies  
Secondary Keywords: NTISDDX  
Distribution Restriction: DISTRIBUTION LIMITATION NOW REMOVED.

5297  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
PHOTOGRAPHIC AND OSCILLOGRAPHIC INVESTIGATIONS OF SPARK DISCHARGES IN  
HYDROGEN  
A.A. Doran and J. Meyer  
University of New England, Armidale, NSW, Australia  
British Journal Of Applied Physics, Vol. 18, pp 793-799 (06/1967).  
The development of spark discharges in near-uniform fields under  
low over-voltage has been studied with nanosecond resolution using  
image converter and intensifier techniques. The results indicate  
three main phases in the development of the discharge from the time  
of initiation by the Townsend mechanism up to the stage where  
complete voltage collapse across the gap is achieved. First, a  
quasi-stable glow-like discharge is built up, then a thin filament  
progresses from the anode to the cathode-fall region. Finally, a  
luminous region moves quickly from cathode to anode, leaving behind  
the highly conducting spark channel. 5 Refs.  
Primary Keywords: Hydrogen Breakdown; Near-uniform Field; Small  
Overvoltage; Three Breakdown Phases; Glow Region;  
Filament; Spark Channel  
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5318

## PICOSECOND RISETIME SWITCH STUDY

J.M. Proud and M.J. Huber  
Ikor Inc., Burlington, MA  
Final rept. (08/1967).  
Availability: AD-826 141/857

NTIS

This effort is part of a program aimed at utilizing nanosecond pulses to provide superior range resolution in long range radar. The generation of nanosecond pulses requires switches with picosecond risetime and jitter capabilities. The objective of this program was to develop the necessary switching techniques in the picosecond time domain. Apparatus and a measurement technique have been developed and applied to high voltage spark gap switching times in the 10 to the minus 11th power sec time domain. The investigation has included study of electrode material and surface condition leading to ultra-fast closure times in highly over-volted gaps brought about by enhanced high field electron emission. Closure times of 50 psec or less have been achieved. Ultraviolet triggering of overvolted gaps has been observed with jitter as low as 25 psec.

Primary Keywords: Electronic Switches; Sparks; Pulse Generators; Electronic Switches; Radar Pulses; Pulse Generators; Gas Discharges; Ultraviolet Radiation; Electrodes

Secondary Keywords: Nanosecond Pulses; Picosecond Rise Time Switches; Rise Time; NTISDDDDX

Distribution Restriction: DISTRIBUTION LIMITATION NOW REMOVED.

5324

## (ENERGY STORAGE, INDUCTIVE)

(Systems)

## THEORETICAL AND EXPERIMENTAL STUDY OF SUPERCONDUCTING INDUCTIVE STORAGE SYSTEMS

O.R. Mawardi, D. Mazony, M.K. Chung and L.D. Holland  
Case Western Reserve University, Cleveland, OH 44106  
AFOSR Report No. AFOSR-76-2886 (10/1978).  
Availability: AD A62078

NTIS

This report covers a two year effort to develop efficient pulse inductive storage sources. Two schemes have been considered in detail. One scheme is based on the electromagnetic dual of the classic Marx generator. In the other scheme a pulse shaping circuit has been used to improve the energy transfer from the storage to the load. In the process of these investigations two types of flux pumps have been investigated. These superconducting devices are ideal to provide the charging current to the inductors. Fast acting pumps were designed and built. Their response is several orders of magnitude better than is currently available. 26 Refs.

Primary Keywords: Inductive Storage; Pulsed; Flux Pump; Shaping Circuit

5325

## (PARTICLE BEAMS, ELECTRON)

(Target Interactions)

## CHARGING DIELECTRICS WITH A BEAM OF CHARGED PARTICLES

A.A. Vorob'yev, O.B. Yevdokimov and A.G. Gusev'nikov

FTD Report No. FTD-IDR(3)T-1448-77 (08/1977).  
Trans. From: Radiatsionnaya Fizika Nemetallicheskikh Kristallov 3, 131-138 (1971) By M.C. Reynolds  
Availability: FTD-IDR(3)T-1448-77

NTIS

This paper discusses the possibility of charging dielectrics with an electron or radiation beam. The authors consider theoretically the two basic aspects of charge deposition in dielectrics: 1) transport, moderation and thermalization of electrons with the creation of volume charge, and 2) drift, capture, and neutralization of thermal electrons. The authors go on to analyze the most likely conditions for charge buildup and show that this buildup is heavily dependent on beam current. The characteristics of the discharge after completion of the charging process is also considered. 5 Refs.

Primary Keywords: Fast Electron Beam; Gamma Ray Beam; Theory; Dependence On Beam Current; Spallation

5326

## (BREAKDOWN STUDIES; PARTICLE BEAMS, NEUTRAL)

(Gas, Electrical; Generation)

## CROSS SECTIONS FOR CHARGE TRANSFER COLLISIONS INVOLVING HYDROGEN ATOMS

Y. Kaneko, Y. Kaneko, T. Itikawa, T. Imai and T. Kato  
Nagoya University, Nagoya, Japan  
No. IPPJ-AM-15, 186p (10/1980).  
Availability: N81-14847/0

NTIS

Experimental data on the cross section for  $H + X$  sup at yields  $H^+(x) + X$  sup ( $x=1$ ) are compiled for any element X and charge state q. The result is shown in graphs as a function of collision energy. A scaling law for the cross section is derived theoretically to provide quantitative information for highly-stripped ions for which no data are available. Cross sections for some related processes are also shown.

Primary Keywords: Charge Exchange; Collision Parameters; Hydrogen Atoms; Plasmas (Physics); Scattering Cross Sections; Excitation; Graphs (Charts); Ion Density (Concentration); Ion Temperature; Nuclear Fusion; Scaling Laws

Secondary Keywords: Foreign Technology; NTISASAE; NTISFNA

5328

## (BREAKDOWN STUDIES; SWITCHES, CLOSING)

(Electrodes; Gas Gaps; Materials)

## ELECTRODE MATERIAL RELEASE DURING HIGH VOLTAGE BREAKDOWN

R.T. Schneider, T.B. McCall III and H.G. Lohmert  
University of Florida, Gainesville, FL  
NASA Report No. NASA CR-107880 (01/1969).  
Availability: NTIS-17442

NTIS

This report begins with a comprehensive survey of the available literature in the areas of vacuum breakdown and electrode erosion. After pointing out some of the deficiencies and strong points of the existing work, the authors proceed to describe an experiment to measure the eroded electrode mass per shot and to ascertain what happens to this eroded mass. The diagnostics used were neutron activation and gamma ray spectrometry. Several erosion patterns are exhibited, along with pictures of typical breakdowns. An analysis is also given for the fate of the material ejected from the electrodes. 49 Refs.

Primary Keywords: Vacuum Breakdown; Prebreakdown; Polarity Effects; Material Release; Aluminum Electrode; Copper Electrode

5329

## (PARTICLE BEAMS; POWER CONDITIONING; SWITCHES, CLOSING; SWITCHES, OPENING)

(Review). Pulse Forming Lines; Gas Gaps; Optical; Explosive Fuses)  
(PARTICLE BEAM FUSION PROGRESS REPORT JANUARY 1980 THROUGH JUNE 1980)  
Sandia Labs, Albuquerque, NM 87115  
Sandia Report No. SAND80-2500 (05/1981).  
Availability: SAND80-2500

NTIS

This report provides an overview of the particle beam fusion effort at Sandia Laboratories for the period of January-June 1980. Sections on vacuum ion diodes, analysis of magnetically insulated convolutes, Marx generator development, laser and X-ray triggering of spark gaps, opening switches, and power flow studies are included, as well as sections on plasma diagnostics and fusion target design and analysis. Reprinted systems are briefly presented. 109 Refs.

Primary Keywords: PBFA; Proto; Ion Beam; Marx Generator; Magnetic Insulation; Spark Gap; Inertial Opening Switch; Power Flow; Resonant Transformer; Reprinted

Secondary Keywords: Particle Beam Fusion; Fusion Target; Plasma Diagnostics

5331

## (ENERGY STORAGE, CAPACITIVE)

(Capacitors)

## CAPACITORS FOR AIRCRAFT HIGH POWER (FINAL REPORT)

R.D. Parker  
Hughes Aircraft Co., Culver City, CA 90230  
AFML Report No. AFML-TR-80-2037 (04/1980).  
Availability: AD 087427

NTIS

This report describes an experimental exploratory development program conducted by Hughes Aircraft Company to develop reliable light-weight pulse discharge capacitors for airborne application. The specific duty was a 1 min. burst every 2 hrs., and both low (50 pps) and high (100 pps) repetition rate service was to be considered. The energy density goals were 400 to 1100 J/kg with a 20 microsec. capacitor pulse width. A five layer polysulfone/kraft paper dielectric was selected for high rate service, while polyvinylidene fluoride/kraft paper was chosen for the low rate service. Both mineral oil and dielectric fluids were used. A highly-instrumented test bay accurately simulated a PFN environment and allowed detailed and accurate testing. Three types of complete capacitors were built, all for high rate service. 0 Refs.

Primary Keywords: Capacitors; Pulse Discharge; Pulsed Capacitors; Pulse Power

Secondary Keywords: Pulse Forming Networks; Energy Storage; Dielectric Systems

5332

## (ENERGY STORAGE, CHEMICAL; PULSE GENERATORS)

(Flux Compression Generators; Flux Compression)

## AN INTRODUCTION TO EXPLOSIVE MAGNETIC FLUX COMPRESSION GENERATORS

C.M. Fowler, R.S. Caird and M.B. Gern  
Los Alamos National Labs, Los Alamos, NM 87545  
LASL Report No. LA-5890-MS (02/1975).  
Availability: LA-5890-MS

LASL

Various types of explosive flux compression generators are illustrated and their relative advantages are compared. Experiments are described in which energy was supplied by these generators. The experiments were selected to show both versatility and limitations of the devices. Generator principles are derived from lumped parameter circuit theory. 15 Refs.

5333

## (BREAKDOWN STUDIES; INSULATION, MATERIAL)

(Surface Flashover; Solid)

## CONTAMINATION EFFECTS ON HVDC INSULATOR FLASHOVER

T. C. Cheng  
University of Southern California, Los Angeles, CA 90007  
EPRI Report No. EPRI EL-1203 (11/1979).  
Availability: EPRI EL-1203

EPRI

An integrated field and laboratory study was conducted to investigate the mechanism of flashover of contaminated insulators under HVDC conditions. The field testing rack, construction at the Sylmar Converter Station, is directly energized by the Pacific HVDC Intertie. Salient factors identified in the field studies were reproduced under simulated conditions in the laboratory for in-depth studies. Effects of various factors were studied one at a time using a highly controllable laboratory testing procedure. Newly discovered phenomena which occur during the flashover process such as formation of clean zones and the deleterious effect of nitrates on insulating materials, were observed. Theories were formulated to explain the mechanisms involved in these phenomena. Electrochemical properties of contaminants and their effects on flashover process were examined. The relationship between single-component salts and multi-component salts was investigated. Experiments on corona initiation on a contaminated insulator were performed. 5 Refs.

Primary Keywords: Insulators; Contamination; HVDC Flashover

Secondary Keywords: HVDC Transmission

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5334

## (PARTICLE BEAMS, NEUTRAL; PARTICLE BEAMS, NEUTRAL; PARTICLE BEAMS, NEUTRAL)

(Generation; Transport; Target Interactions)

## FIELD-REVERSED MIRROR PILOT REACTOR

Authors Unknown (1); Authors Unknown (2) and Authors Unknown (3)

(1) Lawrence Livermore Lab, Livermore, CA 94550  
(2) General Atomic Co., San Diego, CA 92121  
(3) Pacific Gas and Electric Co., San Francisco, CA 94105  
EPRI Report No. EPRI AP-1544 (09/1980).  
Availability: EPRI AP-1544

EPRI

This report concludes a two-year effort to design a near-term small-scale fusion power plant which, through its construction and operation, would be a direct and important step toward the commercialization of fusion energy. The fusion reactor pilot plant was designed under the ground rules that it must produce net power, be compact, have minimum total cost, and use near-term (late 1980's) engineering technology. The neutral beam driven, field-reversed mirror (FRM) was selected as the fusion plasma confinement concept around which the pilot plant was designed. Although the physics data base for this design is not yet well in hand, it is being pursued within the magnetic field-reversal framework of the U.S. Mirror Fusion Program. Depending on the plasma size, the pilot plant would gross up to 19.8 MW(e) and would produce up to 10.7 MW(e) net, with the recuperated power used principally for the neutral beam injectors and refrigeration for the superconducting magnets. 106 Refs.

Primary Keywords: Deuterium Beam; 11 A, 0.2 MeV Beam; Parallel Beamlines; Penning Source; Minimum-B Magnetic Well; Ion Beams; Superconducting Magnet

Secondary Keywords: Reactors; Tritium Handling; Cryogenic System  
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5335

(BREAKDOWN STUDIES)  
(Gas, Electrical)

## STUDY OF ARC BY-PRODUCTS IN GAS-INSULATED EQUIPMENT

Authors Unknown

Gould Inc., Greensburg, PA 15601

EPRI Report No. EPRI EL-1646 (12/1980).

Availability: EPRI EL-1646

EPRI

The project objective was to develop a chemical data base for sulfurhexafluoride, SF<sub>6</sub>/sub 6/ decomposition products as generated by electrical discharges within gas-insulated equipment to serve as a basis for unified handling procedures of faulted SF<sub>6</sub>/sub 6/ equipment and disposal of the arc products. An analysis capability was to be developed that could be used by utilities for incipient and actual fault analysis on SF<sub>6</sub>/sub 6/ insulated power equipment. Arced SF<sub>6</sub>/sub 6/ gas and solid samples were generated in test devices which simulate SF<sub>6</sub>/sub 6/ circuit breakers or SF<sub>6</sub>/sub 6/ insulated bus. Actual production hardware and procedures were used for assembly of the test devices. Fault arc currents ranged between 15 kA and 50 kA. Arced SF<sub>6</sub>/sub 6/ samples were obtained and shipped in stainless steel cylinders. Gaseous arc products were analyzed with a combination of gas chromatography-mass spectrometry. The attained sensitivity is 100 ppm. The major SF<sub>6</sub>/sub 6/ arc products are SOF<sub>2</sub>/sub 2/ and CF<sub>4</sub>/sub 4/. The amount increases with arc energy. SFO<sub>2</sub>/sub 2/ can effectively be removed by absorber-scrubbers containing soda-lime, activated alumina and molecular sieves. 8 Refs.

Primary Keywords: Sulfurhexafluoride Gas; Gas-Insulated Equipment; Arcing In Sulfurhexafluoride; Arc By-Products; Faults In Gas-Insulated Equipment

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5336

(PULSE GENERATORS)  
(Capacitive)

## A PULSED CURRENT SOURCE WITH ENERGY RECOVERY

G.I. Kugushev and M.D. Sukhachev

Instruments And Experimental Techniques, Vol. 17, No. 3, pp 740-741 (06/1974).

Trans. From: Priroda i Tekhnika Eksperimenta 3, 102-103 (May-June 1974)

A pulsed power supply of a magnetic lens having recuperation of energy of the magnetic field of the lens into the storage capacitor is described. Stabilization of the charge of the storage capacitor is achieved by cutting off the charging current. The described principle of designing the source ensures a high rate of charging the storage capacitor for high voltage stability of at least 0.01%; this allows an amplitude stability of the current in the load to be obtained which does not exceed 0.03% at a cycling frequency down to 2 Hz. 3 Refs.

Primary Keywords: Energy Recuperation; Thyristor; Inductive Load; Conservation Of Energy; Charging Circuit; Rep-rated; Low Voltage; Low Current

Secondary Keywords: Magnetic Lens

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5337

(POWER CONDITIONING)  
(Pulse Transformers)

## AIRCORE PULSE TRANSFORMERS FOR HIGHPOWER LASERS

G.J. Rohwein

Sandia Lab., Albuquerque, NM 87115

Laser Focus pp. 70-74 (01/1980).

Aircore pulse transformers are proposed as alternative to Marx Generators as power sources for highpower lasers. The advantages and disadvantages in using the aircore transformers are discussed. A comparison of two types of aircore transformers, the helical-wound type and the spiral-strip version, is made. 4 Refs.

Primary Keywords: Aircore Pulse Transformer; Reduced Height; Reduced Complexity; Flux Linkage; Spiral-strip Transformer

Secondary Keywords: Laser

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5338

(DIAGNOSTICS AND INSTRUMENTATION)  
(Particle Beam)

## THERMAL SENSITIVE PAPER AS A DIAGNOSTIC FOR INTENSE RELATIVISTIC ELECTRON BEAM DYNAMICS

R.M. Gilgenbach, D.B. McDermott and T.C. Marshall

Columbia University, New York, NY 10027

Review Of Scientific Instruments, Vol. 49, No. 8 pp 1998-1999 (08/1978).

Thermal sensitive paper has been used as a diagnostic for an intense relativistic electron beam propagating in a rippled magnetic field. The E x B rotation of the beam has been measured from the exposed pattern on the thermal paper and used to calculate the electrostatic field of the beam and the corresponding values of electron density and beam current. Exposed strips of thermal paper show longitudinal modulation of the radial electron velocity with a period corresponding to that of a rippled magnetic field; modulation of the radial electron velocity at the cyclotron frequency has also been observed. 3 Refs.

Primary Keywords: E-beam Diagnostic; Rippled Magnetic Field; Velocity Modulation; E X B Rotation

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5339

(PULSE GENERATORS; SWITCHES, CLOSING)  
(LC; Thyristors)

## A POWERFUL THYRISTOR MODULATOR

N.M. Gavrilov, B.M. Kozlov and A.V. Stupin

Moscow Engineering-Physics Institute, Moscow, USSR

Instruments And Experimental Techniques, Vol. 17, No. 5, pp 1340-1341 (10/1974).

Trans. From: Priroda i Tekhnika Eksperimenta 5, 84-85 (September-October 1974)

A powerful thyristor modulator is described having the following parameters: pulse power 5 MW; length of the shaped pulse 50 to 300 microseconds; amplitude of the output voltage 120 kV; pulse repetition frequency 1 Hz. The basis of modulator operation is the principle of complete discharge of the shaping line made up of L-C sections through a matched load. The commutator is a controlled thyristor spark gap shunted by avalanche diodes. Devices of this type may be used in accelerator engineering. 4 Refs.

Primary Keywords: Thyristor; L-C Pulse Generator; Pulse Transformer; 500 A Output Current

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5340

(ENERGY CONVERSION, THERMAL)  
(Loads)

## HIGH PULSE POWER FAILURE OF DISCRETE RESISTORS

M. Domingos (1) and DC Munsch (2)

(1) Clarkson College Of Technology, Potsdam, NY 13675

(2) AFML, Kirtland AFB, NM 87117

IEEE Transactions On Parts, Hybrids, And Packaging, Vol. PHP-11, No. 3, pp 225-229 (09/1975).

Theoretical and experimental studies have been conducted on discrete resistors to determine the power required to cause failure as a function of pulse width over the range 1 microsecond to 10 ms. Single pulses of increasing amplitude were applied until voltage breakdown occurred, the resistor shattered, or until a resistance change of 5% or more took place. Carbon composition (both slug and film type), wire-wound (both precision and power type) and film resistors were tested. Computer calculations, temperature cycling tests, and field plots were utilized to interpret the results. 2 Refs.

Primary Keywords: Carbon Resistor; Wire-wound Resistor; Film Resistor; 1 Microsecond-10 Millisecond Pulse Width; Component Destruction

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5343

(PULSE GENERATORS)  
(Systems)

## MULTIPLE-CIRCUIT PULSE GENERATOR FOR HIGH REPETITION RATE RARE GAS HALIDE LASERS

C.P. Wang

The Irvine A. Getting Labs, El Segundo, CA 90245

The Review Of Scientific Instruments, Vol. 49, No. 10, pp 1599-1600 (10/1978).

A multiple-circuit high pulse repetition frequency (PRF) pulse generator for the pumping of rare gas halide lasers is reported. With this multiple-circuit design, high PRF can be achieved by the use of existing low PRF thyatron switches and capacitors. A two-circuit pulse generator was constructed, and its performance is described. By means of this pulse generator and a bloutdown-type fast transverse-flow system, high PRF laser action in XeF was obtained, typically, 6 mJ/pulse at 1 kHz or 6 W average power. High PRF laser action in KrF/sub 2/ was also observed. 12 Refs.

Primary Keywords: Modular Pulse Generator; Low Rep-rate Modules; High Rep-rate System; Capacitive Discharge Circuit

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5344

(PULSE GENERATORS)  
(Line Type)

## COMPACT MEGAWATT AVERAGE POWER BURST PULSE GENERATOR

J.E. Creedon, J. McGowan, A.J. Buffa and S. Schneider

ECOM, Fort Monmouth, NJ 07705

IEEE Transactions On Electron Devices, Vol. ED-26, No. 10 pp 1500-1502 (10/1979).

A compact, lightweight, burst mode pulse generator has been designed and evaluated at a megawatt of average power. The modulator occupies a volume of 0.81 cu m and weighs 225 kg. The recently developed MAPS-40 thyatron and two high-energy density pulse-forming networks (PFN) are used as the switch and energy store. A solid-state end-of-line clipper circuit is included and was found to be essential at high average power loadings. The modulator has been evaluated using a copper sulphate load at 40-kV peak voltage, 40-ke peak current, 10-microsecond pulse width, 40-kA/microsecond current rise, and 50 A of average current at a repetition rate of 125 Hz. Repeated burst on times of 5 s in a 35-s time period have been demonstrated. 4 Refs.

Primary Keywords: High Average Power; Modular Design; Rep-rated; Hydrogen Thyatron; Design Considerations; Small Size

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5345

(PULSE GENERATORS)  
(Hard-tube)

## A BROADBAND PULSE POWER AMPLIFIER

V.D. Dvornikov, S.T. Latushkin and I.I. Yudin

Atomic Energy Institute, Moscow, USSR

Instruments And Experimental Techniques, No. 2, pp 373-375 (04/1969).

Trans. From: Priroda i Tekhnika Eksperimenta 2, 97-99 (March-April 1969)

A circuit is given for a pulse amplifier-shaper that guarantees amplification from 3-5 V to 3 kV with an output current of approximately 20 A in a pulse having a duration of approximately 1 msec. The edges of the output pulse have a duration of 15 to 20 nsec. The amplifier is designed using secondary-emission tubes. The 1Q1-38 output tubes guarantee a pulse power of more than 50 W. 2 Refs.

Primary Keywords: Pulse Amplifier; 5 V Input; 3 kV Output; Fixed Pulse Shape; Secondary Emission Tube; Carrier Pulse

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5346

(SWITCHES, CLOSING; SWITCHES, OPENING)

(Gas Gaps, Electrical); Gas Gaps, Magnetic Field)

## A REPETITIVELY OPERABLE, HIGH-CURRENT INTERRUPTER

R.F. Caristi and D.V. Turnquist

EG&amp;G Inc., Salem, MA 01970

IEEE Transactions On Electron Devices, Vol. ED-26, No. 10 pp 1482-1490 (10/1981).

A series of fast-acting and repetitively operable bimodal gas discharge switches capable of both the initiation and the interruption of high pulse currents at high-voltage levels has been designed, built, and tested. Based on hydrogen thyatron technology, these switches retain most of the characteristics of thyatrons when switching from the open to the closed state. In addition, the interruption of high currents against high source voltages is achieved when an externally generated, pulsed magnetic field is transversely applied to the current by means of a plasma-field interaction region built into the device. The interruption process is rapid (typically requiring less than 10 microseconds), complete (current reduced to zero), and permanent (the current in the device does not restrike even when the field pulse terminates). In general, operation at lower voltages allows the interruption of higher currents for a given magnetic field energy. Typical data are the interruption of 1000 A against 15 kV with a field energy of 8 J, and 100 A against 50 kV with a field energy of 33 J. The theory, design, and construction of such switches are described, and the results of various parametric studies are discussed. 22 Refs.

Primary Keywords: Thyatron-like Operation; Bimodal Gas Discharge; Pulsed Magnetic Field; Design Considerations

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5350  
(SWITCHES, CLOSING)  
(Thyratrons)  
DOUBLE-ENDED THYRATONS IN HIGH-POWER BURST MODE PULSE MODULATOR APPLICATIONS  
R.B. Molyneux-Barry  
GEC Marconi Research Labs, Essex, UK  
IEEE Transactions On Electron Devices, Vol. ED-26, No. 10 pp 1451-1455 (10/1979).

The use of four-gap double-ended thyratons in a 30- to 100-microsecond pulse modulator is described. The PFN-type modulator operates at 185 kV peak, charged from the 11 kV public supply, and powers an ill-matched and potentially unreliable load directly at 30 to 70 kV without a pulse transformer. The maximum repetition rate is 200 pps. The completed modulator has been delivered to the customer and successfully recommissioned. Satisfactory operation is reported with 200-MHz, 6-kJ pulses in bursts of average power up to 400 kW; this is well in excess of the published ratings of the tubes employed. The methods used to obtain this performance are discussed and the main details are given of pulse discharge, energy dump, and switched charge circuits appropriate to the thyratons used. The possibility of uprating the modulator is mentioned, and certain recent developments in large thyratons are discussed. These include a new pentode-type electrode system which should give improved performance with simpler deck circuitry. For extended bursts at long pulse lengths the realistic maximum capability of single tubes in current production seems to be about 1-64 peak at 2-MW average power. 5 Refs.

Primary Keywords: Multigap Thyatron; Pulse Forming Network; Thyatron Systems; Reverse Current Circuit  
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5355  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
A NON-DESTRUCTIVE ACOUSTIC ELECTRIC FIELD PROBE

A. Migliori and J.D. Thompson  
Los Alamos National Labs, Los Alamos, NM 87545  
Journal Of Applied Physics, Vol. 51, No. 1 pp 479-485 (01/1980).  
A new method is described for the non-destructive measurement of electric field and space charge distributions inside solid or liquid insulators by using a non-structured acoustic pulse. The integral equation is derived for the response of the dielectric ringing propagation of an acoustic pulse and some acoustic measurements of electric fields and space charge inside transformer oil and polymethylmethacrylate plastic are described. 7 Refs.  
Primary Keywords: Electric Field Measurement; Space Charge Measurement; Bulk Dielectric; Acoustic Wave  
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5357  
(SWITCHES, CLOSING; BREAKDOWN STUDIES)  
(Vacuum Gaps; Self; Vacuum, Electrical)  
CURRENT GROWTH IN PULSE BREAKDOWN OF A SHORT VACUUM GAP  
G.A. Masys and D.V. Preskurovskii  
Soviet Physics Journal, Vol. 11, No. 1, pp 49-51 (01/1968).  
Trans. From: Izvestiya Vysshikh Uchebnykh Zavedenii. Fizika 11, 81-85 (1968).

The rise time of the current in breakdown of short (up to 1 mm) vacuum gaps is related to the voltage and gap length; this has been examined by initiation involving heating the anode by field-emission current from the cathode. However, optical studies show that the cathode plays the leading part in initiation and current growth. Bright spots appear at the cathode at the start of the monotonic increase in current, and expand toward the anode at about 2E6 cm/sec. The current and the light intensity increase as the spots spread toward the anode, the current reaching a maximum at the anode. 8 Refs.

Primary Keywords: Vacuum Gap; Millimeter Gap; Delay Measurement; Rise Time Measurement; Optical Measurement; Variable Voltage; Variable Gap Spacing  
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5359  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Component Testing)  
THE DAMAGE SUSCEPTIBILITY OF INTEGRATED CIRCUITS TO A SIMULATED IEMP TRANSIENT

M.L. Vault  
Harry Diamond Labs, Washington, DC 20438  
IEEE Transactions On Nuclear Science, Vol. NS-20, No. 6, pp 48-47 (12/1973).

Recent investigations have been directed toward gaining insight into the effect of electrical pulse overstressing in integrated circuits, especially simple gates and bipolar LSI arrays. In order to determine the effect of ionizing radiation on the pulse-power failure susceptibility levels of small scale, monolithic, junction-isolated integrated circuits (simple gates), an experimental study was undertaken such that device failures could be induced in a simulated EMP or IEMP environment. The device types investigated included low and high power, quadruple, dual-input, positive NAND TTL gates. Permanent damage levels for these devices were determined for both positive and negative polarity sub-microsecond pulses, introduced into the input, output and bias terminals of active devices, some of which were simultaneously irradiated by gamma radiation. The failure susceptibility level of a device was found to depend uniquely upon the ionizing radiation; the device terminal subjected to the electrical stress pulse, and the polarity of the pulse. The data for device failures in the simulated EMP environment agree with the existing thermal-failure models characterized by  $P = At/sup m$ , where  $P$  is the power required to induce failure and  $t$  is the time to failure. In the radiation environment it was observed that initial ionization tends to reduce the magnitude of the constant  $A$  and shifts the time to failure  $t$  from the constant-energy regime ( $m = -1$ ) to another. 13 Refs.

Primary Keywords: Digital Integrated Circuits; Bipolar Logic; Ionizing Radiation; Comparison With Thermal-Failure Model  
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5360  
(SWITCHES, CLOSING)  
(Thyratrons)  
THE MAPS-40 BURST-MODE 40-KV MEGAWATT AVERAGE POWER HYDROGEN THYRATRON  
D.V. Turnquist (1), S.S. Marx (1), R.E. Plante (1), N. Reinhardt (1) and J.E. Gredson (2)  
(1) EG&G Inc, Salem, MA 01970  
(2) ECOM, Fort Monmouth, NJ 07703  
IEEE Transactions On Electron Devices, Vol. ED-26, No. 10 pp 1438-1443 (10/1979).

A hydrogen thyatron capable of switching 40 kV and 40 kA in repetitive bursts at the 1-MW average power level is described. Major design problems were obtaining the necessary forward and inverse holdoff capability and controlling the thermal and mechanical effects of the several kilowatts of operating dissipation encountered at this power level. A conventional external anode, planar-electrode, ceramic-metal tube design was chosen to meet the design requirements, which include reliable, kickout-free operation following long periods of standby. Emission was provided by a large cathode specifically designed to handle ohmic heating due to the 1500 A of rms-equivalent pulse current, as well as the heat developed in the surrounding plasma. Massive auxiliary, control, and gradient grids were incorporated into a tightly baffled box-type grid structure of sufficient total aperture area to prevent quenching below 70-80 kA. Molybdenum wall shielding was employed to improve holdoff capability and prevent arc damage. Design and operating considerations are discussed and representative test results for the first 16 tubes are given, together with the results of special tests for high peak current, high average current, and high-voltage holdoff. 13 Refs.

Primary Keywords: MAPS-40 Thyatron; Ceramic Thyatron; High Average Power; Rep-rated; Design Considerations  
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5362  
(SWITCHES, CLOSING)  
(Thyratrons)  
THE PLASMA-HEATED THYRATRON

D. Fleischer (1), D.V. Turnquist (1), S. Goldberg (1) and N. Reinhardt (2)  
(1) EG&G Inc, Salem, MA 01970  
(2) 10 Elliot Rd., Lexington, MA 02173  
IEEE Transactions On Electron Devices, Vol. ED-26, No. 10 pp 1444-1450 (10/1979).

An instant-starting hydrogen thyatron is described which incorporates a cathode requiring no warmup time, no standby power, and no separate heater power supply. Starting cold, time jitter is less than 1 ns; anode delay time is less than 200 ns; and the 0-30 s anode delay time drift is less than 100 ns. The cathode is a self-heating design made of impregnated tungsten. Even when cold, it provides sufficient emission capability to trigger readily and to prevent arcing. During operation, it attains full operating temperature via plasma-heating effects and its own resistive dissipation; after shutdown, it remains active, in readiness for the next cold start, a cycle which can be repeated as often as desired. Thyratrons made with the new cathode display operating behavior and life compatible to conventional hydrogen thyratrons of equivalent size. 4 Refs.

Primary Keywords: Instant-start Thyatron; Tungsten Cathode; Plasma Heating; Cathode Dissipation Heating; Long Life  
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5360  
(SWITCHES, CLOSING)  
(Thyratrons)  
100-KV HYDROGEN THYRATRON WITHOUT GRADIENT GRIDS

L. Mancabo  
Lawrence Livermore Lab, Livermore, CA 94550  
IEEE Transactions On Electron Devices, Vol. ED-18, No. 10, pp 920-924 (10/1971).

A high-power hydrogen thyatron grid-anode structure has been developed using a 5949 thyatron cathode assembly. One such device was operated for 10 h at 2000 A, 32 kV, at 1000 pps with a pulse width of 0.3 microseconds. Another was operated for periods up to 220 h at 1000 A, 100 kV, at a duty cycle of 0.00004. The duty cycle is presently limited by our test modulator circuit. Trigger requirements are 2 kV at 50 ohm with a 2.5-microsecond duration. The jitter was nil when measured with a Tektronix 517 oscilloscope using a sweep speed of 50 ns/cm. The anode delay time is in the range of 1/4 to 1/2 microns. The grid-anode geometry is designed for a minimum anode-grid capacity, thus providing a tube with a higher repetition rate capability. The field emission limit up to 100 kV is not evident in the normal sense in this geometry. 8 Refs.

Primary Keywords: Grid-anode Structure; Nanosecond Jitter; Rep-rated; Paschen's Curve  
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5395  
(PULSE GENERATORS)  
(Line Type)  
HIGH-VOLTAGE NANOSECOND PULSE GENERATOR WITH COMPENSATION USING NONLINEAR COMPONENTS

V.G. Bagorinov, D.V. Iremasvili, A.I. Kolesnikov and M.I. Leont'ev  
Sukhum Physiotekhnical Institute, Sukhum, USSR  
Instruments And Experimental Techniques, No. 5 pp 1179-1182 (09/1969).  
Trans. From: Pribery i Tekhnika Eksperimenta 5, 80-82 (September-October 1969).

A generator is described which generates pulses by means of a two-stage uniform line. The steepness of the leading and trailing edges of the pulse is increased by connecting a compensating LC network with nonlinear inductance to the anode of a thyatron. Voltage pulses of 30-kV amplitude are generated with a load consisting of load resistance 50 ohm and load capacitance 150 pF. The widths of the leading edge, the top, and the trailing edge of the pulse are, respectively, 35, 70, and 40 ns. The pulse repetition frequency is 25 Hz. 4 Refs.

Primary Keywords: Pulse Generator; Pulse Shaping; Nonlinear Inductor; LC Network  
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5402  
(ENERGY CONVERSION, ELECTRICAL)  
(Charging Circuits)  
STABILIZATION OF CHARGING VOLTAGE OF CAPACITIVE ENERGY STORAGE ELEMENTS  
OF HIGH-POWER PULSED DEVICES

A.M. Leonov and M.M. Ofitsarov  
Radiophysical Scientific Research Institute, Gorki State University,  
USSR  
Instruments And Experimental Techniques, No. 1, pp 132-134 (02/1969).  
Trans. From: Pribery i Tekhnika Eksperimenta 1, 123-125  
(January-February 1969)

A simple method of charging-voltage stabilization is described  
whose accuracy is not worse than  $\pm 0.5\%$  for line voltage  
variations of  $\pm 10\%$ ; the method is based on the control of  
thyatron rectifiers. 3 Refs.

Primary Keywords: Thyatron Regulator; Lariouon's Circuit; Feedback  
Circuit

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5408  
(PULSE GENERATORS; ENERGY STORAGE, CHEMICAL)  
(Flux Compression; Flux Compression Generators)  
A COMPRESSED MAGNETIC FIELD GENERATOR SYSTEMS MODEL

J.E. Gover  
Sandia Labs, Albuquerque, NM 87115  
2nd IEEE International Pulsed Power Conference Proceedings, pp 402-405  
(06/1979).

A model relating the volume of a compressed magnetic field  
generator pulsed power system to its electrical energy output is  
developed. This systems model includes energy density and/or power  
density models of the electronic components and a CME generator model  
which has been confirmed experimentally for system output energies up  
to 5000 joules. For a given output energy there exists an optimum  
selection of the pulsed power components to give an overall minimum  
system volume. Under optimum conditions the volume of the CME  
generator is equal to one-half of the overall system volume and the  
overall system volume increases with the one-half power of the  
systems output energy. In an all electronic system there is a linear  
relationship between volume and output energy. 6 Refs.

Primary Keywords: Flux Compression Generator; Analysis; Scaling Laws  
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5412  
(SWITCHES, CLOSING; SWITCHES, CLOSING)  
(Gas Gaps, Electrical); Gas Gaps, Materials)  
CHARACTERIZATION OF HIGH POWER GAS SWITCH FAILURE MECHANISMS

E.E. Molting  
Naval Surface Weapons Center, Silver Spring, MD 20910  
2nd IEEE International Pulsed Power Conference Proceedings, pp 450-453  
(06/1979).

A multistage, 4 MV, low jitter, command triggered gas switch is  
being developed for use on large pulse power devices. Experiments to  
date have shown that the performance and operational life of the  
switch are severely limited by mechanical and electrical failure of  
the insulating housing. Estimates of the internal overpressure  
produced during switch closure have been made which indicate the  
severity of the blast containment problem; this information has led  
to the development of a mechanically stronger switch design. Surface  
analyses performed on both switch electrode and insulator surfaces  
were used to investigate observed electrical failure of the  
insulators. A layer of closely spaced metal particles were found  
imbedded in the insulator walls. 8 Refs.

Primary Keywords: Switch Failure; Very High Voltage; Insulator  
Failure; Surface Analysis; Metal Implantation  
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5413  
(PULSE GENERATORS)  
(Reviews)  
DEVELOPMENT OF HIGH REPETITION-RATE PULSED POWER GENERATORS

R.J. Sojka and G.K. Ince  
Physic International Co., San Leandro, CA 94577  
2nd IEEE International Pulsed Power Conference Proceedings, pp 217-220  
(06/1979).

The design and development of high repetition-rate, (>1 kHz)  
pulsed power generators are discussed and a set of chosen design  
approaches presented. The ensuing technical approaches for the pulse  
forming network, PFN switching, and PFN charging modulators are  
described. Key elements of the system are the deionized-water,  
fast-energy store, and a flowing air spark gap switch, both capable  
of operation at higher than a 1 kHz repetition frequency. Based on  
this design and development effort, the technical issues of high  
repetition rate pulsed power systems are discussed, and  
recommendations are offered for further study and development of  
dielectrics, spark gap switches, and high power modulators. 4 Refs.

Primary Keywords: Pulse Generator; Rep-rated; Design Considerations;  
Pulse Forming Network; Switch  
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5416  
(PULSE GENERATORS; ENERGY STORAGE, CAPACITIVE)  
(Systems; Systems)  
HIGH-DENSITY Z-PINCH PULSE-POWER SUPPLY SYSTEM

M.C. Munnally, L.A. Jones and S. Singer  
Los Alamos National Labs, Los Alamos, NM 87545  
2nd IEEE International Pulsed Power Conference Proceedings, pp 142-147  
(06/1979).

The design and operation of the high-density Z-pinch experiment  
pulse-power supply is discussed. A 600-kV, 1-MA, 75-nH Marx bank is  
designed to charge a 1-ohm, 90-ns, water-insulated transmission line  
to approximately 0.6-1.0 MV. The water line is then discharged  
through a small laser-initiated current channel in 1-5 atm of  
hydrogen. The components of the Marx bank, the trigger system, the  
water line, and the gas load as well as the control system that uses  
fiber optics and air links for monitor and control are discussed. 1  
Refs.

Primary Keywords: Marx Generator; Pulse Forming Line; Low Inductance;  
Control System; Optical Trigger  
Secondary Keywords: Z-pinch  
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5416  
(REVIEWS AND CONFERENCES)  
(Reviews)

OVERVIEW OF INERTIAL CONFINEMENT FUSION

G.W. Canavan  
US Dept. Of Energy, Germantown, MD 20767  
2nd IEEE International Pulsed Power Conference Proceedings, pp 1  
(06/1979).

Progress and plans for the U.S. program in inertial confinement  
fusion are reviewed with emphasis on the pulsed power aspects of  
pulsed driver technology. The program has grown in five years from  
early experiments at the sub-terawatt level to construction of large  
facilities capable of peak power on target of about 100 TW. Driver  
technology options have broadened from glass and CO/sub 2/ lasers to  
short wavelength lasers, electron and light ion beams, and high  
energy heavy ion accelerators. Except for the heavy ion drivers, near  
term emphasis has been placed on single-shot systems to establish  
scientific feasibility at greatly reduced cost compared to rep-rate  
facilities. However, as the program develops attention must be given  
to components and subsystems necessary for reliable rep-rated  
operation. 0 Refs.

Primary Keywords: Fusion; E-beam; Ion Beam; Rep-rated  
Secondary Keywords: Carbon Dioxide Laser; Glass Laser; Abstract Only  
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5417  
(PULSE GENERATORS)  
(Spiral)

HIGH-VOLTAGE SPIRAL GENERATORS

A. Ramrus (1) and F. Rose (2)  
(1) Maxwell Labs Inc., San Diego, CA 92123  
(2) Naval Surface Weapons Center, Dahlgren, VA 22448  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIIC-9 (11/1976).

The performance of Spiral Generators operating at high output  
voltage is described. Generators employing castor oil impregnation  
are compared to those with air insulation. Tests on oil-insulated  
generators with output capacitance of about 1 nF indicate their high  
voltage capability is up to 1 MV. Generator failure at high output  
voltage appears to be caused, in part, by the initial DC charge  
voltage, thereby limiting the allowable stored energy. Recent  
preliminary data suggests this limitation may be overcome by  
including resistive paper in the generator winding. Also discussed  
are switching techniques applicable to Spiral Generators or other  
sources requiring a low-inductance input switch. Solid-dielectric  
multichannel switches are found particularly suitable for Spiral  
Generators. 1 Refs.

Primary Keywords: Spiral Generator; High Voltage; Insulation  
Considerations; Triggering  
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5418  
(ENERGY STORAGE, MECHANICAL)  
(Rotating Machines)  
REBUILDING THE FIVE MEGAJOULE HOMOPOLAR MACHINE AT THE UNIVERSITY OF  
TEXAS

J.H. Gully, K.M. Tolik, R.C. Zowarka, H. Brennan, M.L. Bird, M.F.  
Weldon, M. Rylander and M.H. Mooson  
University of Texas at Austin, Austin, TX 78712  
2nd IEEE International Pulsed Power Conference Proceedings, pp 325-329  
(06/1979).

The role of the 5 MJ homopolar machine at the Center for  
Electromechanics has changed from that of a pulsed power supply  
experiment to that of a power supply for various experiments. Because  
of this change in duty, it was necessary to modify the machine to  
allow more efficient operation and easier connection of the machine  
to the load. The experimental bearings which were on the machine were  
replaced with bearings of a more conventional design. These bearings  
exhibit a high stiffness and lower loss than the original bearings,  
making the machine more reliable and reducing motoring time. The  
surface of the poles were faced to make the applied field more  
uniform over the face of the rotor. This reduced the magnetic moment  
on the rotor and reduced the side forces on the rotor during  
discharge. The busters were built to lower the resistance of the  
output circuit and to allow quicker change of experiments. The  
latching mechanism of the closing switch was rebuilt for better  
reliability and a damper was added to lower the mechanical shock on  
the switch during operation. 2 Refs.

Primary Keywords: Homopolar Generator; Power Supply; High Reliability;  
Bearing Design  
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5419  
(ENERGY STORAGE, CAPACITIVE; PULSE GENERATORS)  
(Systems; Systems)  
STATUS OF THE UPGRADED VERSION OF THE NRL GAMBLE II PULSE POWER  
GENERATOR

J.R. Boller, J.K. Burton and J.D. Shipman Jr.  
Naval Research Lab., Washington, DC 20375  
2nd IEEE International Pulsed Power Conference Proceedings, pp 205-208  
(06/1979).

The GAMBLE II water dielectric pulse power generator, in 1978, was  
the forerunner of the high energy (>50 kJ) class of water dielectric  
generators. It has been redesigned internally to make maximum use of  
its original outer conductor shell and to optimize it for the  
positive ion beam experimentation. The new design also initiates the  
use of an oil dielectric multi-channel switch at the output of the  
pulse forming line. This switch, because of its low capacitance,  
eliminates the need for an extra prepulse switch. The upgraded  
version has been tested up to power and energy levels which are  
nearly twice the original. 0 Refs.

Primary Keywords: GAMBLE II; Water Dielectric; Positive Polarity; Oil  
Switch; Prepulse Suppression  
Secondary Keywords: Ion Beam Generation  
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5425

(SWITCHES, CLOSING; SWITCHES, OPENING)  
(Reviews; Reviews)

A REVIEW OF HIGH-POWER SWITCH TECHNOLOGY

T.R. Burkes, J.P. Craig, M.O. Hagler, M. Kristiansen and M.M. Portney  
Texas Tech University, Lubbock, TX 79409  
IEEE Transactions On Electron Devices, Vol. ED-26, No. 10 pp 1401-1411  
(10/1979).

The basic operation and some of the performance parameters and limitations of various high-power switches with potential for re-rated operation are summarized. The specific switches included are: thyatrons, ignitrons, liquid metal plasma valve, crossed field tube, vacuum tube, spark gaps (gas, liquid, vacuum, and solid), thyristors, transistors, mechanical switches, vacuum arc opening switch, e-beam switches, dielectric surface discharge switches, thermally driven opening switches, and superconducting switches. 55 Refs.

Primary Keywords: Basic Operation; Thyatron; Ignitron; Liquid Metal Plasma Valve; Crossed-field Switch; Vacuum Tube; Vacuum Gap; Spark Gap; Solid State Switch; Surface Discharge Switch; Mechanical Switch; Superconducting Switch

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5431

(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)

HIGH POWER SPARK GAP OPTIMIZATION

Authors Unknown  
Maxwell Labs Inc, San Diego, CA 92123  
MLR Report No. MLR-670 (06/1977).

Availability: MLR-670

NTIS

Maxwell Laboratories presents this final report in completion of the High Power Spark Gap Optimization program. This program was, in effect, a continuation of one started under a contract with Wright-Patterson AFB. In that program, data was obtained in the power range of 1-5 MW to investigate switch performance at re-rates up to 500 pps and at voltages up to 60 kV. For the maximum power experiments, two switches were connected in parallel to reduce the power delivered per switch to about 2.7 MW to maintain minimum pre-fire probability and to demonstrate the feasibility of parallel switches. In the current program, the main experimental objectives were to demonstrate spark gap power above 5 MW per switch and raise operating voltage into the 100 kV range. 3 Refs.

Primary Keywords: Spark Gap; High Power; Medium Voltage; Rep-rated; Theory; Experiment

5432

(BREAKDOWN STUDIES; SWITCHES, CLOSING)

(Gas, Optical; Gas Gaps, Optical)

STUDIES OF TRANSIENT DISCHARGES

P.F. Williams and M.A. Gunderson  
Texas Tech University, Lubbock, TX 79409  
AFOSR Report No. AFOSR-TR-79-1304 (10/1979).

Availability: AD A078894

NTIS

Progress during the time period June 15, 1978 through June 14, 1979 in this program to study the basic physical processes responsible for laser-induced breakdown of spark gaps is reported. Major accomplishments during the period include (1) the measurement of temporally and spatially resolved electron densities during and after the arc phase, (2) the study of the initial buildup of charge and current in these gaps, and (3) improvements in the data acquisition equipment used in the work. Evidence of a shock front seen in the electron density data was obtained. 19 Refs.

Primary Keywords: Spark Gap; Laser Triggering; Breakdown Modeling; Comparison With Experiment

5433

(BREAKDOWN STUDIES)

(Lightning)

ARTIFICIAL TRIGGERING OF LIGHTNING ABOVE GROUND

Fleux R. (1), C. Gary (1) and P. Hubert (2)

(1) Electricite De France

(2) CEA, France

1975 Conference On Lightning And Static Electricity, Abingdon, Berks, U.K. (06/1975).

The results of an attempt to trigger lightning using wire-carrying rockets are presented. The purpose of the experiment is to study the potential rise of the upper portions of high-voltage transmission towers. The rocket was launched from the top of the tower under test and pulled the wire to a height of 780 m in approximately 5 sec. Twenty out of 36 shots proved successful in triggering lightning strokes. Analyses of the triggered strokes are presented briefly, with more complete analyses referred to in the references. 16 Refs.

Primary Keywords: Lightning Triggering; Wire-carrying Rocket; Flash Counter; Field Mill; Radioactive Probe

Secondary Keywords: Electric Transmission Tower

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5434

(BREAKDOWN STUDIES)

(Lightning)

INDUCED VOLTAGES, MEASUREMENT TECHNIQUES AND TYPICAL VALUES

B.J.C. Burrows

Culham Lab, Abingdon, Oxfordshire, UK

1975 Conference On Lightning And Static Electricity, Abingdon, Berks, U.K. (06/1975).

This paper analyzes the voltages induced on internal electronic components and surfaces produced by lightning strikes on the airframe of an aircraft. The induced voltages are classified as either (1) Airframe return circuits or (2) Two-wire circuits. The effects of voltages produced by current flowing in the resistive airframe and effects of voltages induced by magnetic coupling to apertures in the airframe are considered. Detailed theoretical analyses of the interiors of both the fuselage and wing geometries are included. 7 Refs.

Primary Keywords: Lightning Induced Currents; Aircraft; Theoretical Analyses; Geometry Considerations

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5435

(BREAKDOWN STUDIES)

(Lightning)

A SWEPT-STROKE EXPERIMENT WITH A ROCKET SLED

J.A. Dobbing and A.M. Hanson

Culham Lab, Abingdon, Oxfordshire, UK

1978 IEEE Electromagnetic Compatibility Symposium pp 390-395 (06/1978).

A new method of simulating the sweeping of a lightning stroke has been developed using a moving test vehicle and stationary arcs. Realistic aircraft landing and approach speeds were obtained by using the rocket driven sled installation at the Royal Aircraft Establishment, Farnborough. The sled was used to carry a simulated 'wing' at speeds up to 160 mph. A simple arrangement was used to vary the boundary layer. A unidirectional current pulse with an amplitude and duration in the continuing current range was used. This was generated from a lead acid battery and inductive storage system, which was capable of producing arcs more than 5 meters long carrying 600 A. 9 Refs.

Primary Keywords: Lightning Simulation; Swept Stroke; Rocket Sled; Inductive Energy Storage; Damage Levels

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5436

(BREAKDOWN STUDIES; BREAKDOWN STUDIES)

(Lightning; Electrodes)

ARCS ON METAL SHEETS IN SIMULATED LIGHTNING DISCHARGES

P.F. Little, A.M. Hanson and J.A. Dobbing

Culham Lab, Abingdon, Oxfordshire, UK

1977 IEEE Electromagnetic Compatibility Symposium pp 375-380 (06/1977).

This paper presents a simplified physical model of an arc attachment point, and experimental tests of the validity of this model. The extent of melting in a metal sheet due to a constant-current pulse is measured and compared with theory. Using longer pulses or higher currents, a comparison is made of the observed time required to puncture the sheet with the calculated value. From this work major parameters controlling the time to puncture any metal sheet can be identified. The model offers theoretical guidance in determining the minimum metal thickness required for lightning protection and the experimental techniques used here are applicable to simulated lightning tests. 7 Refs.

Primary Keywords: Lightning Simulation; Metal Sheet; Damage Threshold; Puncture Threshold; Experiment; Theory

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5437

(BREAKDOWN STUDIES)

(Lightning)

INDUCED VOLTAGES IN FULL SIZE AIRCRAFT AT 10/SUP 11/ A/S

B.J.C. Burrows, C. Luther and P. Pownall

Culham Lab, Abingdon, Oxfordshire, UK

1977 IEEE Electromagnetic Compatibility Symposium pp 207-214 (06/1977).

The principal results are given of the preliminary work on induced voltages in idealized wing and fuselage models in which quantitative theoretical predictions were confirmed experimentally. A test rig for subjecting a Hawker Hunter fuselage to current pulses with very high di/dt (100 kA/microsecond) is described and measurements of the fuselage current distribution and induced voltages on some selected loops are given. A maximum voltage (excluding the high frequency components) of about 2.5 kV was predicted and measured in the cockpit. The h.f. components in the observed induced voltages were investigated by consideration of the current pulse into the fuselage and it was found to contain many discrete frequencies. The amplitude of the initial h.f. components varied in a complex manner with bank voltage and gap pressure, and so scaling of these transients is totally unreliable. Resonances in the aircraft and return conductor structure are discussed. Suggestions are given for standardized test systems to simulate both the high current effects on the aircraft and the effects of streamer current excitation. 7 Refs.

Primary Keywords: Lightning Simulation; Capacitor Discharge; Theory; Experiment; Resonance; Streamer Excitation

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5438

(BREAKDOWN STUDIES)

(Lightning)

LIGHTNING STRIKE POINT LOCATION STUDIES ON SCALE MODELS

J. Philpott (1), P. Little (1), E.L. White (2), H.M. Ryan (3), C. Powell (3), S.J. Dale (4), A. Aked (4), D.J. Tedford (5) and R.T. Waters (5)

(1) Culham Lab, Abingdon, Oxfordshire, UK

(2) Electrical Research Association, Leatherhead, Surrey, UK

(3) A. Reyrolle &amp; Co. Ltd., Habburn, County Durham, UK

(4) University of Strathclyde, UK

(5) UMIST, Cardiff, UK

1975 Conference On Lightning And Static Electricity, Abingdon, Berks, U.K. (06/1975).

With the multitude of variables involved, the electric fields around an aircraft and, hence, the probability of lightning strike at a given point on the surface of an aircraft is very difficult to calculate. As a result, the authors use the simplified model of a conducting disk with an attached hemispherical vertical post to allow comparison between experiment and theory. An experiment was conducted by placing the simplified model in a point-plane gap and observing the breakdown produced by a pulse generator of variable amplitude, waveshape, and polarity. The size of the model and position in the gap were also varied to provide complete data. The electric fields around the model were calculated and an attempt was made to identify breakdown mechanisms. Results are also presented for detailed models of several aircraft. 8 Refs.

Primary Keywords: Lightning Simulation; Simplified Model; Experiment; Theory; Scale Aircraft Model

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5439

(BREAKDOWN STUDIES)

(Lightning)

RECENT DEVELOPMENTS IN HIGH CURRENT TESTING TECHNIQUES FOR LIGHTNING SIMULATION

A.W. Hanson

Culham Lab, Abingdon, Oxfordshire, UK

1977 IEEE Electromagnetic Compatibility Symposium pp 385-389 (06/1977).

This paper reviews the developments that have taken place in testing techniques employed at Culham since 1975. Generation of high current pulse waveforms, waveshaping, arc testing, swept stroke experiments, testing of entire aircraft, and future plans are discussed. 6 Refs.

Primary Keywords: Lightning Simulation; Pulse Generator; Waveshape; Swept Stroke; Whole Aircraft Test

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3441  
(ENERGY STORAGE, CAPACITIVE; POWER TRANSMISSION)  
(Capacitor Banks; Transmission Lines)  
DESIGN AND CONSTRUCTION OF FAST ENERGY, HIGH VOLTAGE CAPACITOR BANKS  
M. Hesa  
Lawrence Livermore Lab., Livermore, CA 94550  
LLL Report No. UCID-16166 (06/1969).  
Availability: UCID-16166  
NTIS

This report begins with the identification of the basic parts of a capacitor bank and proceeds to describe each component. Switches and charging circuits are described briefly with more detail given to power transmission and to capacitor selection and failure detection. A short discussion on strip lines and insulator strength is included.  
Primary Keywords: Capacitor Banks; Capacitor Selection; Capacitor Failure Detection; Charging Circuit; Switch; Transmission Line; Breakdown Data

3443  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES)  
(Solid, Radiation; Vacuum, Radiation)  
QUICK2: A ONE-DIMENSIONAL CODE FOR CALCULATING BULK AND VACUUM EMITTED PHOTO-COMPTON CURRENTS  
T.A. Dellin (1) and C.J. MacCallum (2)  
(1) Lawrence Livermore Lab., Livermore, CA 94550  
(2) Sandia Labs., Albuquerque, NM 87115  
Sandia Report No. SLL-74-0218 (04/1974).  
Availability: SLL-74-0218  
NTIS

The theory, operational features of the one-dimensional code QUICK2 are described. The code calculates the bulk and vacuum-emitted photo-Compton current of electrons generated in a material exposed to photons with energies from 1 keV to 10 MeV and arbitrary angle of incidence. The rapid and easy-to-use calculational technique is based on analytical solutions to the transport equation modeling electron multiple scattering and slowing down. 16 Refs.  
Primary Keywords: Photo-Compton Current; Bulk Current; Emission Current; Vacuum Emission; Quantum Efficiency; Energy Distribution; Numerical Calculation

3456  
(PARTICLE BEAMS, ELECTRON; PARTICLE BEAMS, ELECTRON)  
(Generation; Transport)  
ADVANCED SIMULATION RESEARCH: VOLUME II-VACUUM ENERGY STORAGE  
M. Clark, A. Mondelli, P. Korn and W. Rostoker  
Maxwell Labs Inc., San Diego, CA 92123  
DNA Report No. DNA 4297F-2 (09/1975).  
Availability: AD A048158  
NTIS

The STP experiment has been placed in operation during this contract period. A number of electron injectors have been explored with the injected charge shown to scale linearly with the injector bias voltage. Injected charge levels of approximately 100 microcoulombs, which corresponds to potential well depths of about 300 kV, have been measured as will be described in this report. Vertical magnetic field coils have been installed on the experiment, and preparations for high-energy electron injection have been completed. 8 Refs.  
Primary Keywords: Magnetic Field; Divertor Loop; Azimuthal Drift; Vacuum Energy Storage

3457  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
AURORA ELECTRON BEAM MODIFICATION  
S.E. Graybill  
Harry Diamond Labs., Adelphi, MD 20783  
HDL Report No. HDL-TR-1852 (07/1978).  
Availability: AD A062931  
NTIS

The AURORA pulser, which normally operates as a pulsed bremsstrahlung machine, has been modified to inject the electron beam from one of the four lines into a drift chamber. The beam obtained from a hemispherical cathode and a machine charging voltage of 90 kV has been studied in detail. This beam of 8 MeV, 240 kA, 200 ns, 300 kJ has produced energy fluences of 10 to 500 cal/sq. cm. The energy deposition profile in three materials has been measured and calculated with reasonable agreement. The beam has been successfully used for structures testing, fluidics circuit irradiation, high intensity bremsstrahlung production, and collective ion acceleration. 12 Refs.  
Primary Keywords: Intense Relativistic Electron Beams; Pinched Beams; Hemispherical Cathode; Energy Deposition Profile

3458  
(ELECTROMAGNETIC FIELD GENERATION)  
(Magnetic)  
COMPRESSION OF A MAGNETIC FIELD BY A SHELL WITH CONSTANT CONDUCTIVITY  
A.Y. Kulago  
FTD Report No. FTD-ID(R317)-0236-78 (03/1978).  
Trans. From: Vestnik Moskovskogo Universiteta 5, 88-91 (1971) By C.S. Mack  
Availability: AD A067828  
NTIS

The authors derive an analytical solution to the problem of an axial magnetic field compressed by an imploding cylindrical conducting shell. Displacement currents are ignored but the finite conductivity of, and field diffusion into, the conductor are included. The limit of infinite conductivity is also taken to show that it reduces to the correct form. The limits of the analysis are demonstrated with a comparison given between the finite and infinite conductivity cases. 10 Refs.  
Primary Keywords: Magnetic Field Compression; Theory; Analytical Solution; Finite Conductivity

3459  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Current)  
CURRENT-MEASURING DEVICES USED WITH THE SUPER-FAST PINCH ASSEMBLY  
S.J. Leonard  
Space Technology Labs Inc., Redondo Beach, CA  
STD Report No. TR-59-0000-00571 (01/1959).  
Availability: AD 609387  
NTIS

It was early recognized that the magnitude of the discharge current in the Super-Fast Pinch Assembly was an important parameter. As a result, several current-measuring devices were built and utilized. In addition, methods were developed for checking the calibration of these current-measuring devices in the required range of 20-100 kA at 17 MHz. For current measurement, solenoidal and toroidal coils were used, and they were calibrated against either a two-turn coil or a shunt. Good agreement was obtained among the current values indicated by the various current-measuring coils and by the two calibrating devices. In the report which follows, the various coils and the shunt are described and a summary of the results is given. 0 Refs.  
Primary Keywords: Current Transformer; Solenoidal Coil; Toroidal Coil; Shunt; High Current; Medium Frequency

3460  
(PARTICLE BEAMS, ELECTRON; PARTICLE BEAMS, ELECTRON)  
(Transport; Target Interactions)  
DEVELOPMENT OF AN INTENSE ELECTRON BEAM ENVIRONMENT FOR MATERIAL CHARACTERIZATION  
D. Dekin  
Physic International Co., San Leandro, CA 94577  
DNA Report No. PIFR-21-979 (10/1978).  
Availability: AD A069155  
NTIS

An intense relativistic electron beam environment has been developed for material characterization. Experimental results on the magnetic compression and expansion of intense beams are presented and compared with theoretical models; emphasis is given to transport efficiency, electron angular distributions, and beam uniformity. Diode energies of 75 kJ are achieved (DNA DML II generator) with greater than 10 percent transport efficiency using a magnetic compression ratio of three. Experimental results have been analyzed in terms of the physics of diode impedance lifetime. Several diagnostics essential for characterizing these intense beams have been successfully demonstrated. 15 Refs.  
Primary Keywords: E-beam; Intense Beam; Magnetic Beam Compression; Materials Response; Beam Diagnostics  
Secondary Keywords: Beam Angles; Material Characterization

3463  
(SWITCHES, CLOSING)  
(Thyratrons)  
ADIABATIC MODE OPERATION OF THYRATONS FOR MEGAWATT AVERAGE POWER APPLICATIONS  
J.E. Creedon, A.J. Buffa and J. McGowan  
ECOM, Fort Monmouth, NJ 07703  
ECOM Report No. ECOM 4470 (02/1977).  
Availability: AD A038687  
NTIS

Significant impact on the size, weight, and cost of high energy pulse systems having short on times can be obtained by designing components to operate in the adiabatic mode. Several thyratron design concepts for short term, high peak and average power switching applications have been studied. They include cavity grid designs for high voltage reliability, grid baffling designs to improve anode take over times, and plasma cathode designs to eliminate standby filament power. Using these concepts, several thyratron designs have been fabricated and evaluated at average powers approaching one megawatt. Evaluation of an off the shelf HY-5 operating in the adiabatic mode, was also conducted. It was found that by modifying the cathode structure the device was capable of being operated reliably at 22.5 amperes of average current at a peak voltage of 15 kilovolts. 1 Refs.  
Primary Keywords: High Power Operation; Cavity Grid Thyratron; Grid Baffling; Plasma Cathode; Performance Test

3465  
(SAFETY)  
( )  
BACKGROUND INFORMATION ON HIGH-VOLTAGE FIELDS  
D.E.J. Jones  
New York University, N.Y. Task Force for Research Planning in Environmental Health Sciences (2nd); Office of Radiation Programs, Silver Spring, Md.; National Inst. of Environmental Health Sciences, Research Triangle Park, N.C.  
Final rept. 1970-76 (02/1977).  
Availability: PB-273 265/95T  
NTIS

To conserve fuel and to provide service as economically as possible, the electric utilities have been increasing the operating voltages of overhead transmission lines. Transmission at 345kV began in the mid-1950s. By 1980, it is estimated that 15% of the transmission capability will be on 765 kV lines and a prototype 1,100 kV line was to be completed in 1976. Although the bulk of the research evidence suggests that there are no prompt or acute adverse effects on biological systems and the environment from electric and magnetic fields associated with such transmissions, few studies have been designed to detect the effects of long-term exposures. Research needs on this subject include studies using existing electric field environments, studies in controlled simulated environments, studies on medical devices, and dosimetry studies. Included as appendices to the paper are several recently published references on biological effects of transmission lines.  
Primary Keywords: High Voltage; Power Transmission Lines; Electric Fields; Magnetic Fields; Exposure; Dosimetry; Electric Coronas; Health; Biology; Research; Requirements; Recommendations  
Secondary Keywords: Environmental Health; Environmental Effects; NTISNINEMHS

5466  
(INSULATION, MAGNETIC)  
( )  
BREAKDOWN OF MAGNETIC INSULATION DUE TO DIAMAGNETISM  
I. Nebenzahl  
Cornell University, Ithaca, NY 14850  
Technical research rept. No. LP5-76, 23p (87/1971).  
Availability: AD-750 658  
NTIS  
A magnetic field can act as an insulator by inhibiting the electrons from transversing a gap between two metallic plates. It is here shown that, if electrons are produced at a high enough rate on the surface of the negative plate, breakdown will occur. The critical current density is given by an equation; or, if the current is space-charge limited, by another equation. The calculation here reported is non-relativistic, i.e.  $(N/\text{sub } 0) \gg (E/\text{sub } 0)$  is assumed.  
Primary Keywords: Electron Beams; Particle Trajectories; Electron Density; Equations Of Motion; Magnetic Fields; Space Charges; Electrostatics  
Secondary Keywords: Diamagnetism; Electron Gas

5468  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
CHEMICAL AND PHYSICAL CHARACTERISTICS OF EXPLODING WIRE PRODUCTS  
I. J. Russell and J. R. Driscoll  
Boston College, Chestnut Hill, MA  
(86/1971).  
Availability: NYO-2756-6  
NTIS  
For abstract, see NSA 25 19, number 45030.  
Primary Keywords: Antimony; Barium; Cerium; Exploding Wire Phenomena; Indium; Iron; Lanthanum; Molybdenum; Neodymium; Ruthenium; Selenium; Strontium; Tellurium; Tin; Yttrium; Zirconium

5470  
TIME-RESOLVED INTENSITY PATTERNS OF THE RADIATION FROM VARIOUS REGIONS OF A VACUUM SPARK DISCHARGE

5472  
(BREAKDOWN STUDIES; INSULATION, MATERIAL)  
(Solid, Electrical; Solid)  
ELECTRICAL CONDUCTION AND ELECTRICAL BREAKDOWN OF ORGANIC INSULATORS AND SEMICONDUCTORS  
N. Ahne, B. Andress, K. Hilsen and P. Roehl  
Siemens AG Research Laboratories, FRG  
Final Report. No. DMFT-FB-T-76-56, 141p (12/1976).  
Availability: NT7-29415/557  
NTIS  
The results of electrical measurements performed on characterized polyethylenes allow formulation of a simplified picture of the conduction mechanism. The conduction current results from electrode-injected electrons and leads to the build-up of a long-lived space charge. Initially the electronic contribution is superposed by a dipolar polarization current, the latter also giving rise to the discharge currents observed. The space charge built up, especially in the presence of impurities and defects, may well influence the electrical breakdown while the material's breakdown strength, of about 800 kV/mm, is relatively unaffected by external parameters.  
Primary Keywords: Electrical Faults; Electrical Insulation; Electrical Resistivity; Organic Semiconductors; Polyethylenes; Charge Transfer; Electrical Measurement; High Voltages; Organic Materials; Power Lines; Space Charge  
Secondary Keywords: West Germany; Dielectric Breakdown; Breakdown(Electronic Threshold); NTISNASAE  
Distribution Restriction: In German; English Summary.

5473  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
EXPLODING WIRE FACILITY  
A. DiGiacomo  
Aerospace Corp, El Segundo, CA 90245  
Technical documentary rept. No. TOR-669(6250-30)-1, 22p (10/1965).  
Availability: AD-674 478/557  
NTIS  
The installation and calibration of the Material Sciences Laboratory's exploding wire facility are described. The facility provides blast pressure pulses used, for example, in determining the vulnerability of the char layer on ablative materials to impulses representative of shock-on-shock loading. In the original configuration the facility was limited to a maximum over-pressure of 10 psi with a duration in the order of 1.5 msec. Modifications, such as the introduction of a straight tube section and the addition of two capacitors, are presently in progress to obtain higher peak over-pressures. (Author)  
Primary Keywords: Exploding Wires; Test Facilities; Calibration; Instrumentation; Shock Tubes; Ablation; Shock Waves; Subsonic Flow; Transducers; Measurement; Stagnation Point; Circuits; Rectifiers; Capacitors; Resistors; Wiring Diagrams; Piezoelectric Gages; Pressure  
Secondary Keywords: NTISDODXD  
Distribution Restriction: Distribution limitation now removed.

5476  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES)  
(Gas, Electrical; Exploding Wires)  
EXPLODING WIRE INITIATION AND ELECTRICAL OPERATION OF A 40-KV SYSTEM FOR ARC-HEATED DRIVERS UP TO 10 FEET LONG  
R. E. Dannenberg and A. P. Slive  
Ames Research Center, Moffett Field, CA  
NASA Report No. NASA TN D-5126 (84/1969).  
This report describes an energy storage and electric-arc driver system for shock-driven facilities. Energy for the arc is supplied from a capacitor bank rated at 1 MJ at an operating voltage of 40 kV. Results are presented for arc discharge lengths of 54 and 116 inches with peak currents of 600 kA. The entire arc strike sequence of exploding wire initiation, dwell period, and subsequent bank discharge is discussed. The composition of the driver gas is shown to be a factor that limits the discharge of stored energy from the capacitor bank. 17 Refs.  
Primary Keywords: Exploding Wire; Long Arc; High Energy Density; Wire Variation  
Secondary Keywords: Shock Driver

5478  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
EXPLODING WIRE RESEARCH 1774-1963  
J. R. McGrath  
Naval Research Lab, Washington, DC 20375  
Memo. rept. No. NRL-MR-1698, 2p (05/1966).  
Availability: AD-633 623  
NTIS

A review of Exploding Wire Phenomena (EWP) research is presented. This review covers the work performed from 1774 to the most current publication. Representative and significant studies are cited to indicate the difficulties associated with EWP research and the recent progress made in overcoming them. (Author)  
Primary Keywords: Exploding Wires; Reviews; Naval Research; Bibliographies; Vaporization; Electric Currents; Explosions; Electrical Properties; Vapors; Spectroscopy; Metals; Light; Sources; Shock Waves; High Temperature Research; Ignition; Aerosol Generators; Theory

5483  
FAIL-SAFE ISOLATION DEVICE PROVIDES MAXIMUM ENERGY TRANSFER FROM EXPLODING WIRE EXPERIMENTS  
O. S. F. Zucker  
Lawrence Livermore Lab, Livermore, CA 94550  
(08/1967).  
Availability: UCID-16P68  
NTIS  
For abstract, see NSA 31 03, number 08119.  
Primary Keywords: Electronic Circuits; Design; Detonators; Efficiency; Electric Fuses; Energy Transfer; Exploding Wires; Fabrication; Failures; Signals  
Secondary Keywords: NTISAEAC

5486  
(ENERGY CONVERSION, MECHANICAL)  
(Rotating Machines)  
HIGH POWER STUDY SUPERCONDUCTING GENERATORS  
A. E. King, C. C. Koube, J. L. McGehee and L. D. Smith  
Westinghouse Electric Corp Line Ohio Aerospace Electrical Div  
Final rept. 2 Jun 75-1 Mar 76 (03/1976).  
Availability: AD-A031 620/857  
NTIS  
This report summarizes the results of a design study of light weight, high power electrical generators in the 10 to 50 Megawatt range with output voltages up to 200 kV dc (after rectification). Superconducting machines representing the latest technology were the focus of the study; non-superconducting machines utilizing the most advanced conventional design technologies were also studied to develop comparable performance data. Turbine requirements and integration features were studied to assure compatibility. A separate analysis of MHD electrical generator designs was also carried out to highlight comparable performance data for that type of power source. (Author)  
Primary Keywords: Generators; Superconductivity; High Power; Lightweight; Magnetohydrodynamic Generators; Turbogenerators; High Voltage; Pulses; Stators; Rotors; Cooling  
Secondary Keywords: Superconducting Generators; NTISDODXA

5487  
(SWITCHES, CLOSING; SWITCHES, OPENING)  
(Miscellaneous Solid State; Miscellaneous Solid State)  
HIGH VOLTAGE, HIGH POWER TRANSISTORS: CHARACTERISTICS OF DEVELOPMENTAL UNITS  
W. M. J. Lawson  
Naval Research Lab, Washington, DC 20375  
Interim rept. no. 8 No. NRL-MR-1132, 17p (01/1961).  
Availability: AD-A045 478/557  
NTIS  
The Radio Corporation of America, under the auspices of Office of Naval Research contract number N00014-61-0-1000, has continued development work on silicon power transistors. Eight state-of-the-art samples of this transistor, designated TA-1891, have been tested by the U.S. Naval Research Laboratory for voltage breakdown, output characteristics and saturation voltage. The breakdown voltage of these units is in the range between 400 and 500 volts, and the characteristic is stable, with no negative resistance region up to 500 volts. Output characteristics, although satisfactory, should be improved, particularly at low collector voltages. Gain and saturation voltage for these ten ampere units are excellent. A fifty percent improvement in the gain would result in a 20 to 25 ampere unit. Thermal resistance could probably be improved, but is, on the average, adequate at this time for 300 watts dissipation. Two transistors are capable of 450 watts dissipation at 25 C case temperature, even in the interim case provided.  
Primary Keywords: Transistors; Acoustic Detection; Test And Evaluation; High Power; High Voltage; Silicon; Electrical Properties; Curves(Geometry); Plotters; Breakdown(Electronic Threshold); Test Fixtures  
Secondary Keywords: MOST-Project-4; NTISDODXA

5488  
(PARTICLE BEAMS, ION)  
(Generation)  
IMPROVED BEAM CURRENT DENSITIES AT HIGH VOLTAGES  
J. M. Fink  
Lawrence Livermore Lab, Livermore, CA 94550  
(06/1976).  
Availability: UCID-17235  
NTIS

The performance of ion extractors is analyzed with crude approximations that show improved performance to be possible with the certain modifications. However, additional studies are required to evaluate the beam optics in the presence of the deformed grids. (ERA citation 02:018620)  
Primary Keywords: Ion Sources; Beam Currents; Beam Extraction; Electrodes; Ion Beams; Plasma  
Secondary Keywords: ERDA/700103; NTISERDA

5489  
(BREAKDOWN STUDIES)  
(Gas, Recovery)  
INVESTIGATION OF HIGH POWER GASEOUS ELECTRONICS  
M.S. Maddix and J.J. Tergola  
Microwave Associates Inc., Burlington, MA  
Quarterly rept. no. 3, 1 Aug-31 Oct 66 (02/1967).  
Availability: AD-698 279/45T  
NTIS

An investigation of the role of electron attaching gases in the performance of TR tubes has continued. Attempts at verifying recovery time theory in bromine and chlorine discharges at higher peak powers than previously, met with no success because of gas contamination attributed to discharge induced wall outgassing. An investigation of the bromine recovery characteristic over a 25 C to 330 C ambient temperature range showed no significant variations. This result indicates that the attachment rate is insensitive to electron energies in the thermal range. The TR attenuation theory has been extended to apply to the discharge period as well as to the recovery period. This extension correlates leakage as well as recovery time to the parameters of an attachment controlled gas discharge. A skin depth theory has been applied to determine electron density and discharge thickness. (Author)

Primary Keywords: Transmit Receive Tubes; Dissociation; Ions; Recombination Reactions; Bromine; Chlorine; Electron Density; Reaction Kinetics; Electric Arcs; Pressure; Attenuation; Gas Discharges

Secondary Keywords: Recovery Time; NTISDODX

Distribution Restriction: DISTRIBUTION LIMITATION NOW REMOVED.

5490  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
INVESTIGATIONS OF THE EXPLODING WIRE PROCESS AS A SOURCE FOR HIGH TEMPERATURE STUDIES  
E.C. Cassidy and S.B.C.W. Abramowitz  
National Bureau of Standards Washington D C  
Interim rept. No. NBS Monograph-109, 59p (11/1968).  
Availability: AD-681 912  
NTIS

Numerous experiments with electrically exploded wires are described. The results include time-resolved measurements of electrical energy, power, voltage, and current during the discharge; periodic still and high-speed photographs of the entire explosion process; integrated and time-resolved measurements of the intensity and spectral distribution of the radiation emitted; and time-resolved absorption spectra from the products of the discharge, with emphasis on observations of the spectrum of the AlO molecule. The apparatus, instrumentation, and fast-measurement techniques developed in order to permit these direct experimental observations and measurements, under the extreme and transient conditions of the explosive discharge, are also described. Results from calculations of the composition, entropy, enthalpy, and density of the explosion mixture are given. (Author)

Primary Keywords: Exploding Wires; High-temperature Research; Aluminum; Exploding Wires; Standardization; Reviews; Design; High-speed Photography; Electric Discharges; Oxygen; Alumina; Entropy; Enthalpy; Spectra (Visible + Ultraviolet); Spectroscopy

Secondary Keywords: Time Resolved Spectroscopy

Distribution Restriction: Availability: Paper copy available from Superintendent of Documents GPO, Washington, D. C. 20402, \$0.55.

5491  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES; BREAKDOWN STUDIES)  
(Gas, Electrical; Gas, Electrical; Reviews)  
ELECTRICAL BREAKDOWN OF GASES: THE PREBREAKDOWN STAGE  
E.E. Kunhardt  
Texas Tech University, Lubbock, TX 79409  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 3, pp 130-138 (09/1980).

In this paper, a review of the theories and experiments devoted to the understanding of the development of the electrical breakdown of a gas insulated gap, i.e., the switching delay, is presented. The presentation is chronological. The classical Townsend and streamer models for breakdown are discussed, followed by a brief account of the continuous acceleration and avalanche-chain models. These last two models have been proposed primarily to describe breakdown at large electric fields. Then, the two-group model for breakdown at voltages above approximately 20-percent self-breakdown is presented. Finally, a brief analysis is given of the present state of the field and the direction it is taking. 61 Refs.

Primary Keywords: Prebreakdown Current; Gas Breakdown; Townsend Ionization; Streamer Theory; Continuous Acceleration; Avalanche-chain

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5492  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Current)  
MEASUREMENT OF FAST RISE TIME MEGAPERE CURRENTS BY QUARTZ GAUGE  
R.R. Williams, D.M. McDaniel and R.W. Stinnett  
Sandia Labs., Albuquerque, NM 87115  
Sandia Report No. SAND 80-0460C (08/1980).  
Availability: SAND 80-0460C  
NTIS

Quartz gauges have been used on the Sandia National Laboratories Proto II accelerator to measure current in the magnetically insulated transmission lines at the 11 MW power level. The accelerator delivers 3.5 MA at 2E14 A/s in a 40 ns pulse to a 0.0127 m diameter aluminum liner to produce a high density plasma. At this radius and dI/dt levels, the B-dot monitors no longer function for the measurement of load current because the monitor suffers electrical breakdown. Quartz pressure gauges mounted at a radius of 0.0086 m have successfully measured the magnetic pressure due to the load current with nanosecond temporal resolution. 2 Refs.

Primary Keywords: Quartz Pressure Gauge; Magnetic Pressure; Fast Rise Time; Very High Current; No Field Perturbation

5494  
(INSULATION, MATERIAL)  
(Solid)  
PHOTOCONDUCTIVITY OF HIGH VOLTAGE SPACE INSULATING MATERIALS: MEASUREMENTS WITH METAL ELECTRODES  
H.T. Coffey and J.E. Nanevich  
Stanford Research Institute, Menlo Park, CA 94025  
Interim Technical Report, 1 Jul. 1974 - 1 Apr. 1975. No. NASA-CR-152839, 31p (04/1975).  
Availability: NTIS  
M77-23365/85T

The electrical conductivities of high voltage insulating materials were measured in the dark and under various intensities of illumination. The materials investigated included FEP Teflon, Kapton-K, fused quartz, and parylene. Conductivities were determined as functions of temperature between 22 and 100 C and light intensity between 0 and 2.5 kW/m<sup>2</sup>. The thickness dependence of the conductivity was determined for Teflon and Kapton, and the influence of spectral wavelengths on the conductivity was determined in several cases. All measurements were made in a vacuum to simulate a space environment, and all samples had metallic electrodes. The conductivity of Kapton was permanently increased by exposure to light; changes as great as five orders of magnitude were observed after six hours of illumination.

Primary Keywords: Electrical Resistivity; Kapton (Trademark); Photoconductivity; Teflon (Trademark); Electrical Insulation; Light (Visible Radiation); Solar Arrays; Temperature

Secondary Keywords: NTISNASA

5495  
(SWITCHES, CLOSING)  
(Vacuum Gaps, Plasma-injection)  
PLASMA-INJECTION VACUUM ENERGY DIVERTER (CROWBAR)  
H.S. Dunkerley  
General Electric Co., Schenectady, NY 12301  
Rept. no. 4 (Final), 1 Jul 64-30 Jun 65 (02/1966).  
Availability: AD-678 494/85T  
NTIS

The purpose of this program was to conduct a theoretical and experimental study toward establishing design concepts for high-voltage energy diverters. The approach utilized the relatively new principle of plasmod injection for triggering the breakdown of a high-vacuum multiple-section gap. After the metallic arc conduction period the gap returns to a high-vacuum state and voltage hold-off capability, ready for a subsequent controlled operation by the plasmod trigger. Studies were made on the effects of electrode material, geometry, sputtering, vacuum conditions, external geometry, methods of generating the plasmod, electron and ion densities and their rate of propagation through vacuum, the trigger geometrical arrangement and location with respect to the hold-off electrodes, use of multiple triggering elements, factors influencing operating range, use of variable spacing and triggering speed, power-handling capabilities and recovery characteristics. The principles studied were used to construct a model of a high-power triggered vacuum gap with an operation objective of 350,000 volts DC. The limited tests results on the model are presented and recommendations for further work. (Author)

Primary Keywords: Plasmas (Physics); Energy Management; Electric Discharges; Trigger Circuits; Electric Arcs; Switching Circuits; Electric Insulation; Plasma Jets; Electrodes; Erosion; Electron Tubes; Ions; Performance (Engineering); Injection

Secondary Keywords: Crowbar; Energy Diverters; NTISDODX

Distribution Restriction: Distribution limitation now removed.

5498  
A 20 KV, NANOSECOND-RISE-TIME PULSE GENERATOR USING KRYTRONS

5499  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
RADIATION GENERATION FROM EXPLODING WIRE  
M.G. Bhattacharya, J.P. Craig and T.F. Frost  
Texas Tech Univ Lubbock Dept of Electrical Engineering  
Final rept. (08/1976).  
Availability: AD-031 007/85T  
NTIS

A theoretical investigation has been performed on the dual nature of the experimentally observed x-ray spectra emitted by high power exploded wire plasmas. The observed spectra consist of a steeply decreasing region for photon energies below about 8 KeV followed by a nearly constant region above this value. The region of steep decrease is the result of Bremsstrahlung from plasma electrons having a Maxwellian distribution. The constant region was considered as being caused by non-thermal high energy electrons. The constant region was investigated in more detail. They calculated first the Bremsstrahlung spectrum that would result from mono-energetic electrons of 5, 10, 20, 50 and 100 KeV incident on tungsten targets. All the spectra were found to have the same flat shape. The case of non-Maxwellian distribution of electrons was examined by using a distribution function appropriate to a homogeneous plasma in a strong electric field. After integration it was found that the spectrum changed from steep to flat as a function of time. It was concluded that a flat spectrum may arise through a distortion of the electron distribution function in a strong electric field. (Author)

Primary Keywords: Exploding Wires; Electromagnetic Radiation; Bremsstrahlung; X Rays; Plasmas (Physics); High Voltage; Photons; Mathematical Analysis; Statistical Distributions; Pulses

Secondary Keywords: NTISDODXA

5501  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
RECORDING SHOCK WAVES AND EXPLODING WIRE ELECTRICAL CHARACTERISTICS  
Y.A. Kotov and M.A. Melnikov  
FID, Wright-Patterson AFB, OH  
No. FID-MT-24-184-68, 15p (07/1968).  
Availability: AD-685 489  
NTIS

A system for the recording of shock-wave velocities and the current and voltage in an exploding wire is described. The purpose of the present work is to create a source of shock waves with controllable (variable) parameters. The solution of the problem consists in the strict synchronization of the basic elements of the system. The circuitry and its operation are described and its components discussed. (Author)

Primary Keywords: Exploding Wires; Electrical Properties; Shock Waves; Recording Systems; Measurement; Measuring Devices (Electrical); Electronics; Optical Equipment; Synchronization (Electronics); USSR

Secondary Keywords: Translations

5504  
(INSULATION, MAGNETIC)  
(1)

**SIMULATION OF POWER FLOW IN MAGNETICALLY INSULATED CONVOLUTES FOR PULSED MODULAR ACCELERATORS**

D.B. Seidel, B.C. Coplen and J.F. VanDevender  
Sandia Labs, Albuquerque, NM 87115  
Sandia Report No. SAND 80-1241C (07/1968).  
Availability: SAND 80-1241C  
NTIS

Recent advances in the technology of magnetic insulation have led to the design of a new class of high power modular accelerators such as PBFA I which is nearing completion at Sandia National Laboratory. In this accelerator, power is fed inward along 36 radially converging, magnetically insulated transmission line (MITL) modules. In many applications, these 36 modules must be recombined into a central magnetically insulated convolute. This recombination can have a significant effect upon magnetic insulation, primarily due to the inevitable lack of simultaneity between power pulses in the 36 MITL modules. In this paper, two distinct simulation approaches for magnetic insulation are developed which can be used to address the question of nonsimultaneity. First, a two-dimensional model for a two-module system is simulated using a fully electromagnetic, two-dimensional, time-dependent particle code. Next, a nonlinear equivalent circuit approach is used to compare with the direct simulation for the two module case. The latter approach is then extended to a more interesting three-dimensional geometry with several MITL modules. 16 Refs.

Primary Keywords: Combinations Of Power From Several Modules; Pulse Simultaneity; Simulation; Numerical Calculation; Particle Code; Nonlinear Equivalent Circuit  
Secondary Keywords: Particle Beam Fusion

5508  
(BREAKDOWN STUDIES)  
(Exploding Wires)

**TERMINATED EXPLODING WIRE ENERGY SOURCE**

L.A. Rosenthal  
Naval Ordnance Test Station, Pasadena, CA  
No. NOLTR-65-12, 2p (04/1965).  
Availability: AD-618 478  
NTIS

By placing a discharge or 'dump' tube across an exploding bridge wire load, it is possible to bypass the electrical energy and terminate the explosion of the wire. The dump tube is triggered by a signal derived from the energy removed from the storage capacitor. (Author)

Primary Keywords: Exploding Wires; Explosive Initiators; Explosive Initiators; Exploding Wires; Capacitors; Circuits  
Secondary Keywords: Exploding Bridge Wires

5509  
(BREAKDOWN STUDIES)  
(Exploding Wires)

**THE APPLICATION OF P.W. BRIDGMAN'S 'NEW EMF' TO EXPLODING WIRE PHENOMENA**  
K.G. Moses and T. Kornoff  
Temple University, Philadelphia, PA 19122  
Availability: AD-602 915  
NTIS

P.W. Bridgman propounded the possible existence of a 'New emf' generated in a conductor carrying a current due to a time varying temperature. This emf was not detected by any researchers due to the fact that the magnitude of this generated voltage is very small under normal conditions. However, under the conditions of an exploding wire the magnitude of the emf can become increasingly important. It is shown that this effect can possibly account for the excess energy required to melt and vaporize a wire under the extreme conditions of a rapid discharge. (Author)

Primary Keywords: EXPLODING WIRES; ELECTRICAL PROPERTIES; VOLTAGE; THERMODYNAMICS; WIRE; MELTING; VAPORIZATION; ENERGY; HALL EFFECT; CAPACITORS  
Secondary Keywords: BRIDGMAN EFFECT

5513  
(DIAGNOSTICS AND INSTRUMENTATION; DIAGNOSTICS AND INSTRUMENTATION;  
PARTICLE BEAMS, ELECTRON)  
(Current; Voltage; Generation)

**VOLTAGE AND CURRENT MEASUREMENTS IN MIXED DIODES**

J.D. Silverstein  
Harris Diamond Labs, Adelphi, MD 20783  
Technical memo. No. MDL-TR-77-6, 126p (08/1977).  
Availability: AD-A043 971/157  
NTIS

Capacitive-voltage (V) monitors and shunt-resistor (I) monitors have been fabricated for the Harris Diamond Laboratories. High-Intensity Flash X-Ray Facility. Sensitivities of these monitors have been measured to an accuracy of 10 percent or better by improved pulse techniques. The monitors were used to measure V and I pulses at charge voltages between 2.8 and 5.0 MV for both high- and low-impedance (Z) diodes. For the high-Z diode, consisting of a hemispherical cathode and a planar anode, Z increases from 70 to 120 ohms as the cathode-anode gap is increased from 1.5 to 3.8 cm. For the low-Z diode, whose cathode and anode are both planar, Z increases from 7 to 33 ohms as the cathode-anode gap is increased from 0.4 to 1.4 cm. Electron energy spectra calculated from the V and I pulses are in reasonable agreement with those measured previously by means of a magnetic spectrometer. There is also general agreement between the time variation of gamma dose rate calculated from the V and I pulses and that measured with a scintillator-photodiode. However, the doses obtained by integrating the calculated dose rates are, on the average, 78 percent lower than those measured with CaF<sub>2</sub>-Mn thermoluminescent dosimeters. (Author)

Primary Keywords: Pulses; Measuring Instruments; Monitors; Diodes (Electron Tubes); Voltage; Electric Current; Field Emission Tubes; Flash Radiography; X Ray Apparatus; Electrical Impedance; High Voltage; Capacitors; Shunts; Resistors; Electron Energy  
Secondary Keywords: HTSDDXA

5516  
(SWITCHES, OPENING)  
(Explosive Fuses)

**CHARACTERISTICS OF A MAGNETIC ENERGY STORAGE SYSTEM USING EXPLODING FOILS**

J.N. DiMarzio and L.C. Burkhardt  
Los Alamos National Labs, Los Alamos, NM 87545  
Journal Of Applied Physics, Vol. 41, No. 9, pp 3894-3899 (08/1970).

A capacitor bank operating at 15 kJ is used to energize an inductive system of 40 nH. Interrupting the current of approximately 800 kA, by means of an exploding copper foil fuse, produces voltages across the fuse of the order of 80 kV. The opening time of the fuse, as well as the characteristics of the voltage developed across the fuse are examined as a function of the fuse dimensions. If transfer of the current into a matching inductive load is to take place at the time of peak voltage, energy transfer efficiency is of the order of 8% with 1-dot's of the order of 2E12 A/sec. 9 Refs.

Primary Keywords: Copper Foil Fuse; 15 kV Charging Voltage; 80 kV Outout Voltage; Multilayer Fuse

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5517  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)

**HIGH VOLTAGE PROBE FOR LIQUID IMMERSION**

N.W. Harris  
Naval Research Lab, Washington, DC 20375  
The Review Of Scientific Instruments, Vol. 45, No. 7, pp 961-962 (07/1974).

A capacitive voltage divider for the measurement of very high voltage transients in liquid-filled transmission lines has been developed. The probe is suitable for pulse lengths in the range 10 nsec to 1 microsecond, and peak voltages between 50 kV and 10 MV. The divider automatically compensates for changes in dielectric constant and loss. 0 Refs.

Primary Keywords: Capacitive Voltage Divider; Liquid Filled; Transmission Line; 10 MV Voltage Range; Compensation  
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5518  
(SWITCHES, OPENING)  
(Explosive Fuses)

**HIGH-POWER PULSE STEEPENING BY MEANS OF EXPLODING WIRES**

G.S. Jones and H. Keritz  
Arco-Everett Research Lab, Everett 49, MA  
The Review Of Scientific Instruments, Vol. 30, No. 11, pp 1032-1037 (11/1959).

A circuit technique is described which reduces the rise times of high power pulses by means of exploding wires. This circuit is a nonlinear lumped parameter transmission line. The magnetic energy is stored in the interstage lead inductances and rapidly transferred into (or more correctly, shared with) succeeding stages by the vaporization of exploding wire resistive fuse elements connected in shunt between the leads. In our case, each of three resistive fuse elements consisted of 20 to 50 parallel 0.001-in diam copper wires held in place across a 2-in. gap with pressure sensitive tape. An empirically determined arrangement is described wherein we have increased the maximum rate of current rise from 300000 amp/microsecond to 800000 amp/microsecond. Using this technique, a magnetic field of 10000 gauss is built up in 0.15 microsecond throughout a volume 4 cm in length and 10 cm in diameter. It will be shown that the best results are obtained with high conductivity fuse materials such as copper or aluminum. Similarity theorems are presented for the design of pulse steepening elements for use with circuits having similar pulse shapes but different energies and characteristic impedances. 0 Refs.

Primary Keywords: Pulse Steepening; Nonlinear Lumped Parameter Line; Multiple Stages; Copper Wire; Aluminum Wire; Dimensional Analysis  
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5519  
(PARTICLE BEAMS, ELECTRON)  
(Generation)

**MICROSECOND DURATION INTENSE RELATIVISTIC ELECTRON BEAMS**

M. Friedman and M. Ury  
Naval Research Lab, Washington, DC 20375  
The Review Of Scientific Instruments, Vol. 43, No. 11, pp 1659-1661 (11/1972).

A preliminary study was performed to ascertain the feasibility of delivering large quantities of electrical energy in relativistic electron beams of long pulse duration. An electron beam of 8 kA peak current and 250 kV peak voltage was produced with a duration of >1 microsecond. The electron beam was transported through a 1 m long drift tube with little energy loss. 9 Refs.

Primary Keywords: Long Duration E-beam; Foilless Diode; Drift Tube; Guiding Magnetic Field  
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5520  
(BREAKDOWN STUDIES)  
(Exploding Wires)

**EXPLODING WIRES IN STRONG AXIAL MAGNETIC FIELDS**

E.M. Honig, M. Kristiansen and M.O. Hagler  
Texas Tech University, Lubbock, TX 79409  
Journal Of Applied Physics, Vol. 44, No. 14, pp 1923 (04/1973).

Thin copper wires, typically No. 27 and No. 32, were exploded in magnetic fields up to 72 kG. The ambient gas was atmospheric pressure air. The wire lengths were 0.5-1.35 cm, the applied voltage 3-7 kV, the peak currents 3.5-39 kA, and the ringing frequency 300 kHz. The effect of the magnetic field was generally to increase the pause length and to increase damping of discharge. 1 Refs.

Primary Keywords: Exploding Wire; Copper Wire; Magnetic Field; 72 kG Field; Air; Increased Current Pause  
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5521  
(SWITCHES, OPENING)  
(Explosive Fuses)  
RAPID TRANSFER OF MAGNETIC ENERGY BY MEANS OF EXPLODING FOILS  
C. Maisonnier, J.G. Linhart and C. Gourlan  
Lab Gas Ionizzati, Euratom-CHEM, Frascati, Italy  
The Review Of Scientific Instruments, Vol. 37, No. 10, pp 1380-1384  
(10/1966).  
Rapid transfer of magnetic energy to an inductive load is usually done by discharging a condenser bank, but it can, in principle, also be done by using inductive storage. The problem then is how to open quickly a switch carrying a large current. Using a thin (10 micron) cylindrical foil of aluminum as a switch, energies of the order of 1E4 J have been transferred into an inductance of about 1E-8 H in a few times 1E-7 sec. An elementary theory of the explosion of the foil is presented, and it is shown to agree well with experimental results. Technical problems associated with the construction of such a fast switch can be considered solved up to an energy level of at least 100 kJ. 5 Refs.  
Primary Keywords: Cylindrical Aluminum Foil; Experiment; Theory; Conductivity; Temperature Considerations  
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5527  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
COMPUTATION OF AXIAL AND RADIAL DEVELOPMENT OF DISCHARGES BETWEEN PLANE PARALLEL ELECTRODES  
A.J. Davies, C.J. Evans, P. Townsend and P.M. Woodison  
University College of Swansea, Singleton Park, Swansea, Wales  
Proceedings Of The IEE, Vol. 124, No. 2, pp 179-182 (02/1977).  
A two-dimensional numerical calculation for the simulation of axially symmetric discharges is presented. Calculations simulating experiments done in nitrogen were made. The simulated shutter and streak photographs were found to agree well with those obtained in the experiments. As the cathode streamer neared the cathode, the calculation failed due to instabilities that developed. 10 Refs.  
Primary Keywords: 2-D Ionization Growth; Plane Electrodes; Parallel Electrodes; Calculated Field Distribution; Photon Flux  
COPYRIGHT: 1977 IEE

5531  
DIELECTRICS STUDY: FINAL REPORT  
DNA Report No. DHA2823F (06/1972).  
0 Refs.

5532  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Electrodes; Gas Gaps, Materials)  
EXPLOSIVE ANODE EROSION IN HIGH CURRENT SPARKS  
K. Schonbach and M. Fischer  
Angewandte Physik, Technische Hochschule Darmstadt, Darmstadt, FRG  
Applied Optics, Vol. 9, No. 7, pp 1695-1697 (07/1970).  
Anode jets believed to be formed by an explosion of material at the anode of a spark gap are studied. The authors discuss the relationship of the jet with current rise, electrode electrical conductivity, thermal conductivity, and boiling point for lead, copper, tungsten, and aluminum. The temporal development of the spark channel and anode jet are presented. It is concluded that the anode jet is formed by local heating of electrons incident on the anode. 4 Refs.  
Primary Keywords: Anode Jet; Turbulence; Anode Drop; Dependence On Cathode Material; Thermalization  
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5533  
(BREAKDOWN STUDIES; REVIEWS AND CONFERENCES)  
(Reviews; Reviews)  
INVESTIGATIONS INTO ELECTRICAL DISCHARGES IN GASES  
B.N. Klyverfal'd Ed.  
All-Union Institute, Moscow, USSR  
Publisher: The Macmillan Co., NY (01/1964).  
Trans. From: The Collected Papers Edited By B.N. Klyverfal'd By D. Cossutta  
This book is a collection of 12 papers by Russian authors concerning discharges in gases and mercury vapor. The first two papers concern the initial phase of self-sustaining discharges in several gases with pd combinations that fall to the left of the minimum of the Paschen curve. Two more papers follow on the plasma spreading of the early part of a discharge and on cathode effects. A good paper follows on postdischarge recovery in several gases. The last seven papers concern processes that occur in mercury vapor arcs (including cathode effects) that include cathode spot observation, temporal histories of mercury vapor densities in discharges, and anode effects. 128 Refs.  
Primary Keywords: Self-sustaining Breakdown; Polyatomic Gas; Nonuniform Field; Plasma Spread; Postbreakdown Recovery; Mercury Arc; Cathode Effects; Anode Effects; Plasma Density  
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5534  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES)  
(Gas, Electrical; Surface Flashover)  
SWITCHING SURGE AND IMPULSE SPARKOVER CHARACTERISTICS OF LARGE GAP SPACINGS AND LONG INSULATOR STRINGS  
T. Udo  
Central Research Institute of The Electric Power Industry, Tokyo, Japan  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-84, No. 4, pp 304-309 (04/1965).  
This paper describes the results of sparkover tests made with impulse voltages and switching surges for large gap spacings and long insulator strings under both dry and wet conditions. The tests were conducted at the Shiohara Outdoor Laboratory; a 10,000-kV 750-kJ surge generator was used. 6 Refs.  
Primary Keywords: Impulse Voltage; Wet Conditions; Dry Conditions; 10 Meter Gap; Air Gap; Cylinder-cylinder Gap  
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5535  
(BREAKDOWN STUDIES)  
(Lightning)  
TECHNIQUES OF STRIKE TESTS ON STRUCTURES, COMPONENTS AND MATERIALS  
A.W. Hanson  
Culham Lab, Abingdon, Oxfordshire, UK  
1975 Conference Of Lightning And Static Electricity, pp 1-12 (01/1975).  
The lightning simulation facilities at Culham Laboratory are described. The design philosophy behind the pulse generators utilized are discussed, with a comparison with the known characteristics of natural lightning presented briefly. A swept stroke experiment is briefly described. The testing philosophy and various materials responses (heat damage, magnetic forces, etc.) to simulations are discussed in some detail. 0 Refs.  
Primary Keywords: Lightning Simulation; Pulse Generator; Swept Stroke; Heat Damage; Induced Effects; Test Philosophy; Diagnostics  
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5536  
(PARTICLE BEAMS, ELECTRON)  
( )  
THE GAMBLE I PULSED ELECTRON BEAM GENERATOR  
O. Cooperstein, J.J. Condon and J.R. Boller  
Naval Research Lab, Washington, DC 20375  
Journal Of Vacuum Science And Technology, Vol. 10, No. 6, pp 981-984 (12/1973).  
Several modifications, including lengthening of the pulse forming line, lowering the output pulse amplitude, and sharply reducing the prepulse amplitude have been made to the Gamble I electron beam generator. The generator, which consists of a Marx generator charging a water-insulated intermediate storage capacitor feeding a water-insulated pulse forming line, now produces a beam of 750 keV electrons. The major component changes include substitution of triggered gas switches for the previously used water switches and construction of a new diode insulator. 12 Refs.  
Primary Keywords: Gas Switch; Diode Insulator; Impedance Transforming Line; Prepulse Reduction  
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5537  
(PARTICLE BEAMS, ELECTRON; INSULATION, MAGNETIC)  
(Generation)  
TWO SPECIES FLOW IN RELATIVISTIC DIODES NEAR THE CRITICAL FIELD FOR MAGNETIC INSULATION  
K.D. Bergeron  
Sandia Labs, Albuquerque, NM 87115  
Applied Physics Letters, Vol. 28, No. 6, pp 306-308 (03/1976).  
An analysis of space-charge-limited counterstreaming flow of ions and electrons in a high-voltage planar diode in the presence of a strong transverse magnetic field is presented. A two-component one-dimensional cold-fluid model is used which includes most self-consistent effects. A substantial enhancement of ion current by a factor of 3-6 is found at fields slightly larger than the critical magnetic insulation field. 14 Refs.  
Primary Keywords: Counterstreaming Flow; Space-charge-limited; Planar Diode; Ion Current Enhancement; Magnetic Insulation; Critical Field  
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5538  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Current)  
SURGE MEASUREMENT ERRORS INTRODUCED BY COAXIAL CABLES  
J.M. Park  
National Bureau of Standards, Washington, DC 20234  
Communication And Electronics, Vol. 77, Pt. 1, No. 37 pp 343-347 (07/1958).  
The author considers measurement of pulsed voltages and, in particular, the errors introduced by the coaxial cables used to transmit diagnostic data between sensor and recording medium. Attenuation of the signal due to losses in the conductors and dielectric of the cable are considered, as well as errors introduced by variation in the cable impedance with frequency. Cable termination is also discussed. Suggestions are included for minimization of error and correcting for inherent errors. 4 Refs.  
Primary Keywords: Coaxial Cable; Measurement Error; Attenuation; Impedance Variation With Frequency; Termination  
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5539  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
THE MECHANISM OF THE LONG SPARK FORMATION  
I. Gallinberti  
Padova University, Padova, Italy  
Journal Of Physics, Vol. 40, No. 7, pp C7-193-C7-250 (07/1979).  
Trans. From: Journal De Physique 40, C7-193-C7-250 (Juillet 1979).  
The authors present several theoretical and experimental results on the physics of long sparks. The mechanism of breakdown is followed through initiation of ionization through conductive arc channel. The air gap considered is a rod-plane type with a positive pulse applied to the rod. The effects of incident radiation is also considered. Diagnostics are discussed. 134 Refs.  
Primary Keywords: Long Spark; Rod-plane Gap; Early Phases; Pulse Voltage; Experiment; Theory; Modeling; Diagnostics

5543  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
COMPUTER SIMULATION OF RAPIDLY DEVELOPING GASEOUS DISCHARGES  
A.J. Davies, C.S. Davies and C.J. Evans  
University College of Swansea, Singleton Park, Swansea, Wales  
Proceedings Of The IEE, Vol. 118, No. 6, pp 816-823 (06/1971).  
A detailed description is presented of the numerical simulation of a high-growth-rate gaseous discharge. The main feature of this simulation are Townsend ionization and field distortion due to the presence of space charge. The simulation proceeds from an initially uniform field with a small core of electrons emitted from the cathode to full breakdown. Cathode and anode streamers are predicted successfully. Agreement with the experimental results of Wagner in nitrogen are seen to be good. 7 Refs.  
Primary Keywords: Townsend Breakdown; Space Charge; Electric Field Distortion; Anode Streamer; Cathode Streamer; Numerical Simulation  
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5545  
(ELECTROMAGNETIC COMPATIBILITY)  
(Grounding And Shielding)  
COUPLING BETWEEN OPEN AND SHIELDED WIRE LINES OVER A GROUND PLANE  
R.J. Mohr  
Cutler-Hammer Inc., Deer Park, NY  
IEEE Transactions On Electromagnetic Compatibility, Vol. EMC-9, No. 2,  
pp 34-45 (09/1967).  
Convenient expressions are derived which permit accurate  
determination of induced interference in open unshielded wire and  
shielded wire or coaxial lines due to AC and transient currents.  
Curves and tables are presented for obtaining key parameters in the  
calculation of interference. The limitations of the derived  
expressions are set forth and an example interference problem is  
solved. Experimental verification of the analysis is presented. 7  
Refs.  
Primary Keywords: Analytical Expressions; Coupling Coefficient;  
Several Geometries; Attenuation Effectiveness;  
Experiment; Theory  
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5547  
(ELECTROMAGNETIC COMPATIBILITY)  
(Grounding And Shielding)  
ELECTROMAGNETIC-INTERFERENCE CONTROL  
E.F. Vance  
Stanford Research Institute, Menlo Park, CA 94025  
IEEE Transactions On Electromagnetic Compatibility, Vol. EMC-22, No. 4,  
pp 319-328 (11/1980).  
The use of shield topology concepts to design interference control  
is described. Starting with the postulate that electromagnetic  
environments can be separated by closed shield surfaces, the proper  
design of essential compromises such as insulated power and signal  
conductors, and openings for access and ventilation are deduced. The  
role of grounding is described and the relation of grounding  
conductors to shield surfaces is deduced. Some guidelines are given  
for determining how effective the shield needs to be. It is concluded  
that the effectiveness of a shield is usually limited most by  
interference propagating on insulated conductors passing through the  
shield, followed by leakage through apertures and diffusion through  
the shield walls. 8 Refs.  
Primary Keywords: Shield Topology; Grounding; Design Considerations;  
Effectiveness Analysis  
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5549  
(ELECTROMAGNETIC COMPATIBILITY)  
(Grounding And Shielding)  
GEOMETRICAL EFFECTS ON SHIELDING EFFECTIVENESS AT LOW FREQUENCIES  
D.A. Miller and J.E. Bridges  
Illinois Institute of Technology, Chicago, IL  
IEEE Transactions On Electromagnetic Compatibility, Vol. EMC-8, No. 4,  
pp 174-186 (12/1966).  
A frequent approach to computing the magnetic shielding  
effectiveness of enclosures is to consider the effect of a plane wave  
impinging on a sheet of infinite extent. This permits an analysis  
based on a transmission-line characterization. However, when the  
wave-length is large compared to the dimensions of the enclosure,  
other analytical approaches provide better results. It has been shown  
that the current distribution on a box-like object scattering in the  
Rayleigh region tends to concentrate at the edges and corners of the  
box. This leads to concentrations of the magnetic field in the  
vicinity of edges and corners both inside and outside the enclosure.  
Since the effects of the current concentrations are localized, the  
magnetic shielding problem can be simplified by assuming a uniform  
current distribution on the exterior of the enclosure. Under this  
assumption the so-called 'circuit approach' can be applied. 10 Refs.  
Primary Keywords: Low Frequency; Corner Effects; Shorted Transformer;  
Mutual Impedance; Leakage Impedance; Circuit  
Approach; Scattering Theory; Comparison  
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5550  
(REVIEWS AND CONFERENCES; ELECTROMAGNETIC COMPATIBILITY)  
(Reviews; Grounding And Shielding)  
GROUNDING AND SHIELDING TECHNIQUES IN INSTRUMENTATION  
R. Morrison  
Dynamics Instrumentation Co.  
Publisher: John Wiley And Sons, Inc., New York, London, Sydney (01/1967).  
Though proper grounding and shielding techniques are an important  
consideration in any pulsed power system, these are often not dealt  
with until they become a difficult problem. The author of this book  
shows, beginning with basic field theory, how to incorporate proper  
grounding and shielding systems into a pulsed power environment.  
Consideration is given to choosing an earth ground for the system and  
to dealing with the power system grounds. Both electrostatic and  
magnetic shielding techniques are presented.  
Primary Keywords: Grounding; Shielding; Instrumentation; Field Theory;  
Power Supply Isolation; Isolation Transformer  
COPYRIGHT: 1967 JOHN WILEY & SONS, INC.

5551  
(ELECTROMAGNETIC COMPATIBILITY)  
(Grounding And Shielding)  
LOW-FREQUENCY SHIELDING EFFECTIVENESS OF A DOUBLE CYLINDER ENCLOSURE  
F.A.M. Rizk  
Hydro-Quebec Institute of Research, Verennes, Quebec, Canada  
IEEE Transactions On Electromagnetic Compatibility, Vol. EMC-19, No. 1,  
pp 14-21 (02/1977).  
The low-frequency shielding effectiveness of a long double  
cylinder shield is determined through a solution of Maxwell's field  
equations. The shielding expression obtained is then compared with  
the results obtained by both the circuit approach and the  
transmission line analogy. The findings of the present paper are also  
compared with the analysis by previous authors of the multishield  
problem. A digital computer program for numerical evaluation of the  
effectiveness of a double cylinder shield is developed and used to  
study the influence of the shield dimensions and material constants.  
15 Refs.  
Primary Keywords: Low-frequency Shielding; Double Cylinder; Maxwell's  
Equations; Analytical Solution; Planar Shielding  
Approach; Circuit Approach; Transmission Line Analogy  
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5552  
(ELECTROMAGNETIC COMPATIBILITY)  
(Grounding And Shielding)  
MAGNETIC SHIELDED ENCLOSURE DESIGN IN THE DC AND VLF REGION  
A.K. Thomas  
TRW Systems Group, Redondo Beach, CA  
IEEE Transactions On Electromagnetic Compatibility, Vol. EMC-10, No. 1,  
pp 142-152 (03/1968).  
A review of magnetic shielding concepts and equations as applied  
to ideal shield configurations has provided a basis for the analysis  
of the shielding effectiveness of practical shielded enclosures to DC  
and VLF magnetic fields. The permeability of the shield material is  
considered as a function of the induction, and a significantly  
improved method of estimating the induction and permeability of the  
shield is presented. The effects of multiple shell geometry are given  
by the equations of this analysis, which are indeterminate with a  
transmission line analysis. The degrading effects of other departures  
from ideal shield materials and configurations are analyzed  
qualitatively; equations for estimating the magnitude of those  
effects are developed where possible. 15 Refs.  
Primary Keywords: Magnetic Shielding; Shielding Concepts; Design  
Criteria; Induction Estimation; Multiple Shields  
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5554  
(REVIEWS AND CONFERENCES; ELECTROMAGNETIC COMPATIBILITY)  
(Reviews; Grounding And Shielding)  
NOISE REDUCTION TECHNIQUES IN ELECTRONIC SYSTEMS  
H.W. Ott  
Bell Labs, Whippany, NJ  
Publisher: John Wiley & Sons New York, London, Sydney, Toronto  
(01/1976).  
This book presents a comprehensive study of electrical noise and  
its elimination. The basic mechanisms of noise generation are  
presented with methods included for the reduction of each type.  
Grounding and shielding techniques for the elimination of coupling  
between circuits are discussed in detail with quantitative  
comparisons given of various configurations. Protection circuits for  
mechanical switch contacts are included. Inherent noise sources  
(thermal noise, shot noise, etc.) are discussed with reduction  
techniques included. Though this book is designed to be utilized with  
electronic circuits, almost all of the techniques presented can be  
used in a pulsed power environment. 108 Refs.  
Primary Keywords: Grounding; Shielding; Electrostatic; Magnetic;  
Capacitive Coupling; Inductive Coupling; Radiative  
Coupling; Thermal Noise; Shot Noise; Filtering;  
Coding  
Secondary Keywords: Mechanical Switch  
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5557  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
THE CATHODE FALL OF AN ARC  
R.C. Mason  
Research Labs, Westinghouse Elec. And MFG. Co., East Pittsburgh PA  
Physical Review, Vol. 38, pp 427-440 (08/1931).  
Schottky and classical theory are used to derive the energy  
distribution of electrons in the cathode fall of an arc. Both  
thermionic and field emission at the cathode are considered with the  
main thrust of the paper centering around a theoretical study and  
experimental test of Langmuir's theory of required high field for  
field emission of electrons. Conclusions are presented that either  
Langmuir's theory is incorrect on a very complicated ionization  
process occurs to produce the required positive ions. 26 Refs.  
Primary Keywords: Cathode Fall; Thermionic Emission; Field Emission;  
Space Charge; Langmuir's Theory  
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5558  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
THE FALL OF POTENTIAL IN THE INITIAL STAGES OF ELECTRICAL DISCHARGES  
J.C. Street and J.W. Beams  
University of Virginia, VA  
Physical Review, Vol. 38, pp 416-426 (08/1931).  
Data are presented concerning the voltage history of the early  
stages of gas discharges in this paper. The fall of the discharge  
voltage in air, nitrogen, hydrogen, and CO/sub 2/ are investigated  
for the pressure range 50-140 cm of Hg and seem to be in good  
agreement with Toepfer's discharge law. Possible methods are  
discussed for increasing the rate of voltage fall for discharges in  
these gases. 13 Refs.  
Primary Keywords: Voltage Fall; Time History; Several Gases; Wide  
Pressure Range; Impulse Voltage  
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5559  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
THE MECHANISM OF THE ELECTRICAL BREAKDOWN OF AIR IN UNIFORM FIELDS AT  
VOLTAGES UP TO 400 KV  
J. Dutton and W.T. Morris  
University College of Swansea  
British Journal Of Applied Physics, Vol. 18, pp 1115-1120 (03/1967).  
This paper presents the results of the measurement of  
pre-breakdown currents at a pd of over 12000. Voltages of 16 to 400  
kv constrained the fields to the less than 60 kV/cm, which reduced  
field emission to a negligible level. The secondary ionization  
coefficient was measured and found to be highly dependent on the  
condition of the cathode surface. Experimentally observed values of  
ionization growth agreed well with the generalized Townsend equation  
in all cases. 13 Refs.  
Primary Keywords: Pre-breakdown Current; Uniform Field; Secondary  
Ionization Coefficient; Townsend Discharge; Modified  
Fowler-Nordheim Equation  
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5569  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
TRANSITION FROM THE PRIMARY STREAMER TO THE ARC IN POSITIVE  
POINT-TO-PLANE CORONA

T. Suzuki  
University of California, Berkeley, CA  
Journal Of Applied Physics, Vol. 42, No. 10, pp 3766-3777 (09/1971).  
This paper reports for the first time measurements with multiple techniques delineating the complete sequence of events from the primary streamer to the thermalization of a highly ionized channel to the arc phase in the common spark transition for relatively small point-to-plane gaps. The observations cover a range of point diameters from 0.1 to 2 mm, for gaps in room air from 1 to 4 cm long, covering the whole range of potentials from streamer onset to in excess of 30% above the standard sparking threshold. It is shown that starting with the primary streamer, which occasionally at its start creates photoionization up to the midgap and at the cathode, there is produced a succession of ionizing waves of potential starting in many cases on the arrival of its tip at the cathode. These waves, observed by photomultipliers as well as by current pulses over a period of some microseconds, create what has been called a 'secondary streamer' by Hudson and Loeb. Unless overvoltage exceeds 30%, the electron density and temperature in the resulting channel are not adequate to thermalize to an arc. Above this value, thermalization occurs in several hundred nanoseconds. At lower overvoltages, there is a dark phase lasting at low values for hundreds of microseconds. 26 Refs.  
Primary Keywords: Streamer; Arc Channel; Spark Transition; Photoionization; Cathode Effects; Thermalization  
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5562  
(BREAKDOWN STUDIES)  
(Gas, Microwave)  
EXPERIMENTAL INVESTIGATION OF THE TRANSIENT FORMATION OF A  
MICROWAVE-GENERATED IONIZED SHEATH IN AIR  
S. E. El-Khemy and R. E. McIntosh  
University of Massachusetts, Amherst, MA 01002  
Journal Of Applied Physics, Vol. 44, No. 1, pp 100-105 (01/1973).  
Microwave and photometric techniques are used to study the temporal and spatial behavior of a transient microwave-generated air plasma sheath in a coaxial transmission line. In particular, breakdown times, stabilization times, and thickness of the ionized sheath are investigated at different pressures and generating signal amplitudes. 22 Refs.  
Primary Keywords: Microwave Ionization; Coaxial Transmission Line; Breakdown Time; Diagnostics  
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5564  
(BREAKDOWN STUDIES)  
(Solid, Electrical)  
SOME ASPECTS OF DIELECTRIC BREAKDOWN OF SOLIDS  
D. B. Watson, W. Hayes, K. C. Kao and J. H. Calderwood  
Royal College Of Advanced Technology, Belford, UK  
IEEE Transactions On Electrical Insulation, Vol. EI-1, No. 3, pp 30-37 (11/1965).  
The electric strengths of sodium chloride, polythene, and polymethyl methacrylate were measured using direct and impulse voltages at room temperature. The effects of specimen thickness, electrode radius, and rate of rise of applied field are different in degree from material to material, indicating the importance of prebreakdown conditions. It is suggested that the final breakdown mechanism is of the avalanche type, heating by prebreakdown current and the formation of space charges being factors affecting its occurrence. 21 Refs.  
Primary Keywords: Dielectric Strength; Several Materials; Impulse Voltage; Several Geometries; Analysis Of Mechanisms  
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5566  
(BREAKDOWN STUDIES)  
(Surface Flashover)  
THE EFFECT OF CUPROUS OXIDE COATINGS ON SURFACE FLASHOVER OF DIELECTRIC  
SPACERS IN VACUUM  
J. D. Cross and T. S. Sudarshan  
University of Waterloo, Waterloo, Ontario, Canada  
IEEE Transactions On Electrical Insulation, Vol. EI-9, No. 4, pp 146-150 (12/1974).  
An experimental investigation of the effect of a cuprous oxide coating upon the surface flashover of high-density alumina in vacuum is reported. It is shown that such coatings improve the impulse strength of the system and eliminate the conditioning effect observed in the case of uncoated specimens at DC and 60-Hz voltages. An explanation of the observed behavior is given in terms of a surface charging model. It is postulated that the improvement in the insulation by the coatings is due to a reduction in the secondary electron emission yield. 8 Refs.  
Primary Keywords: Coating; Increased Breakdown Strength; No Conditioning Effect; Low Frequency Field; Modeling; Surface Charge  
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5567  
ELECTRODYNAMIC PULSE GENERATOR  
A. I. Bertinov and D. A. But  
FTD, Wright-Patterson AFB, OH  
No. FTD-ID(RS)T-2092-77, 10p (12/1977).  
Availability: AD-A065 8-3/55T  
NTIS  
No abstract available.  
Primary Keywords: Pulse Generators; Translations: USSR  
Secondary Keywords: Patents: NTISDDXX; NTISFNUR

5569  
(SWITCHES, CLOSING)  
(RBDT)  
COMPLETE CHARACTERIZATION STUDIES PROVIDE VERIFICATION OF RBDT (RSR)  
RELIABILITY  
J. B. Brewster (1) and G. F. Sherbondy (2)  
(1) Westinghouse Electric Corp., Pittsburgh, PA  
(2) Westinghouse Electric Corp., Youngwood, PA  
IEEE Transactions On Electron Devices, Vol. ED-26, No. 10 pp 1462-1468 (10/1979).

This paper presents the latest characterization information available for a two-terminal, high-speed, solid-state switch previously called the RSR (Reverse Switching Rectifier) but presently referred to as the RBDT (Reverse Blocking Diode Thyristor). Studies of the RBDT have been continuing, leading to broader pulse loss characterization than had previously been available. Loss characterization and trigger studies were made concurrently, and the results show that with proper triggering, the RBDT will function reliably and with minimum loss. New test equipment, which tests to customer specified load conditions is described. The paper concludes with a summary of field originated life data, which supports the conclusion that the RBDT may be effectively and reliably applied for short-pulse, high-current, high rate-of-rise duty. 3 Refs.  
Primary Keywords: Reverse Blocking Diode Thyristor; Reverse Switching Rectifier; Characterization; Losses; Triggering  
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5572  
(ENERGY CONVERSION, THERMAL)  
(Loads)  
LOW-INDUCTANCE, LOW-IMPEDANCE MEGAWATT AVERAGE POWER LOAD  
W. Wright Jr.  
ECOM, Fort Monmouth, NJ 07703  
IEEE Transactions On Electron Devices, Vol. ED-26, No. 10 pp 1556-1559 (10/1979).  
A compact, low-inductance, 0.5-ohm, 1-MW average power resistive load has been developed to facilitate testing of the MAPS-40 thyatron. The flowing liquid electrolyte system uses the large thermal mass of a storage tank of electrolyte to store the energy which is dissipated through a heat exchanger after the high-power run. The electrolyte starting temperature, flow rate, and allowable temperature rise determine the maximum average power into the load; the external and internal spacings and flow uniformity determine the maximum peak power; the flow rate and storage volume determine maximum running time. The load assembly consists of two parallel glass pipes 10.2 cm in diameter and 15.25 cm long. The active volume in each pipe is 6.35 cm long and is contained between electrodes 8.9 cm in diameter. The two sections of the load are electrically in parallel and flowing in series, putting both flow connections at ground potential. The major problem was getting the internal flow pattern uniform to eliminate local boiling and arcing across the bubbles while keeping the pressure drop low and flow high. The calculated inductance of the load assembly is 11 nH, and the structure lends itself to coaxial connections which reduce the overall inductance still further. Material compatibility with the electrolyte will be discussed. 3 Refs.  
Primary Keywords: Dummy Load; High Average Power; Low Inductance; Low Resistance; MAPS-40 Thyatron; Design Considerations  
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5573  
(PULSE GENERATORS)  
(Systems)  
MODULATOR CHARGING SYSTEM UPGRADE FOR A 5-MEV ELECTRON ACCELERATION  
D. Rogers Jr., W. Dexter, L. L. Reginato and A. Zimmerman  
Lawrence Livermore Lab., Livermore, CA 94550  
IEEE Transactions On Electron Devices, Vol. ED-26, No. 10 pp 1509-1511 (10/1979).  
The Lawrence Livermore Laboratory is currently constructing a new linear induction accelerator with a higher beam current than the Astron accelerator. The new accelerator, called the Experimental Test Accelerator (ETA) will be a 5-MeV, 10-kA accelerator with a pulsewidth of 50 ns. Like the Astron, the principle of magnetic induction is used to obtain a linear accelerator. The modular accelerating cavities form essentially a 1:1 transformer and the change in flux in the ferrite core induces an axial electric field for the acceleration of electrons. Since the total energy storage for the ETA is much greater than the requirement for Astron, the power system, the capacitor bank, and the modulator charging system all had to be modified to provide an overall regulation of 0.1 percent. This strict regulation of the charging voltage is necessary for pulse-to-pulse repeatability. 2 Refs.  
Primary Keywords: Electron Linear Accelerator; Hard Tube Modulator; Charging Circuit; Power Supply; High Average Power; Very Good Voltage Regulation  
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5574  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
IMPULSE-VOLTAGE BREAKDOWN CHARACTERISTICS OF LARGE GAPS AT LOW PRESSURES  
M. R. Nanegopal and M. V. Gopalakrishna  
Indian Institute of Science, Bangalore, India  
Journal Of Applied Physics, Vol. 42, No. 13, pp 5874-5876 (12/1971).  
A study of the gap breakdown voltage characteristic at a low pressure of  $10^{-5}$  Torr with a standard (1/50)-microsecond impulse-voltage wave reveals an agreement with the criterion  $V_{sub} 5/\tau = C_d/\rho_{sub} 0.5$  suggested by Cranberg. Voltage-time-to-breakdown characteristics have also been determined. From these studies, it is concluded that impulse breakdown in vacuum is initiated by an electron current heating an anode spot and thereby liberating a cloud which causes breakdown. 3 Refs.  
Primary Keywords: Breakdown;  $10^{-5}$  Torr Pressure; Impulse Voltage; Cranberg Criterion; Delay Measurement; Anode Heating  
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5575  
(SWITCHES, CLOSING)  
(LASS)  
OPTICAL DRIVE REQUIREMENTS FOR LASER-ACTIVATED SEMICONDUCTOR SWITCHES  
P.G. McMullin and L.R. Lowry  
Westinghouse Electric Corp, Pittsburgh PA  
IEEE Transactions On Electron Devices, Vol. ED-26, No. 10 pp 1469-1472  
(10/1979).

Laser-activated semiconductor switch (LASS) devices of the thyristor type exhibit three regimes of operation. At low optical drive, optical triggering is obtained with delay time before conduction and relatively low current rise rates. At intermediate drive levels, fast switching is obtained with no appreciable delay time and fast current rise rates (greater than 10 A/s) but with substantial power loss in the switch element. At higher optical drives, saturated switching is observed with the rise rate and power loss relatively independent of the optical drive level. LASS thyristors of 1- and 4-kV operating voltage ratings have been characterized in the lossy fast switching regime. For pulses of 100-ns duration, the devices act as resistive elements. The magnitude of the resistance varies inversely with the optical drive, and can be understood as conductivity modulation of the conduction path by the photo-generated carriers. Such characterization allows switch system design tradeoff between the required optical drive level and the tolerable power loss in the switch elements. 4 Refs.

Primary Keywords: Thyristor; Optical Triggering; Variation With Trigger Level; Small Delay; Fast Rise; Performance Test

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5576  
GENERATOR OF POWERFUL CURRENT PULSES  
F.M. Spevakova and A.M. Stokov

FTD, Wright-Patterson AFB, OH  
No. FTD-ID-RS-0050-78, 9p (01/1978).  
Availability: AD-A066 671/95T

NTIS

No abstract available.

Primary Keywords: Electric Generators; Magnetic Fields; Electric Current; Current Regulators; Translations; USSR  
Secondary Keywords: Pulse Generators; NTISDODXA; NTISFNUR

5577  
(BREAKDOWN STUDIES; INSULATION, MATERIAL)  
(Surface Flashover; Solid)  
COLLOQUIUM ON ELECTRICAL BREAKDOWN ON INSULATING SURFACES  
T.A.J. Kitchens

Office of Naval Research, London, UK  
Conference rept. No. ONR/C-1-76, 8p (01/1976).  
Availability: AD-A021 853/75T

NTIS

A one-day colloquium on electrical breakdown on insulating surfaces was held by the Institution of Electrical Engineers in London on 6 November 1975. Three introductory talks and a half a dozen contributed papers were given summarizing the state of the knowledge of electrical breakdown in practical systems and some recent research on various aspects of the subject. (Author)

Primary Keywords: Electric Discharges; Insulation; High Voltage; Electrical Insulation; Electrical Properties; Surfaces; Vacuum; Decomposition  
Secondary Keywords: Electrical Breakdown; Hydrofluoric Acid; Insulating Materials; NTISDODXA; NTISDODN

5578  
(PARTICLE BEAMS, ION)  
(Generation)  
DEPENDENCE OF THE ION CURRENT ON VOLTAGE IN A REFLEX TRIODE  
C.A. Kapetanakis, J. Golden and W.M. Black

Naval Research Lab, Washington, DC 20375  
Physical Review Letters, Vol. 37, No. 18, pp 1236-1239 (11/1976).

Results are reported on the dependence of the current of a pulsed ion beam produced in a reflex triode upon the applied resistive voltage in the range 0.6 to 1.3 MV. The measured peak ion current at the maximum voltage tested is 20 kA, corresponding to a current density of 200 A/cm<sup>2</sup>. 14 Refs.

Primary Keywords: Ion Beam Generation; Reflex Triode; 0.6-3 MV Voltage Range; 20 kA Current

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5580  
(SWITCHES, CLOSING)  
(LASS)  
DEVELOPMENT AND APPLICATION OF LIGHT ACTIVATED SILICON SWITCHES  
J.S. Roberts, D.R. Moss and R.A. Hill

Westinghouse Research and Development Center, Pittsburgh PA  
Final rept. May 68-May 70 No. 69-9F6-DESAN-R2, 130p (05/1970).  
Availability: AD-870 913

NTIS

Light activated silicon switches (LASS) were fabricated and devices tested in a flexible test modulator built specifically for LASS testing. Various types of light triggering were investigated including radiation from GaAs laser diode, xenon flash lamp, incandescent lamp and Q-switched neodymium (Nd<sup>3+</sup>) laser. Devices were fired singly and in series at pulse currents of 500 amperes and di/dt's of 1000 amps/microseconds using GaAs laser diodes as light trigger. Using the Q-switched Nd<sup>3+</sup> laser resulted in extremely high speed device turn-on with forward voltage transient over in 20 nanoseconds. A redesign of the early prototype encapsulation was necessary to achieve large pulse current capability. (Author)

Primary Keywords: Electronic Switches; Excitation; Excitation Light Pulses; Modulators; Xenon Lamps; Diodes (Semiconductor); Gallium Arsenides; Lasers; Encapsulation; Trigger Circuits  
Secondary Keywords: Silicon Switches; Light Activated Devices

5581  
(ENERGY STORAGE, MECHANICAL)  
(Rotating Machines)  
DEVELOPMENT OF SOLID AND/OR LIQUID-METAL COLLECTORS FOR ACYCLIC MACHINES  
R.L. Rhodenizer  
General Electric Co, Schenectady, NY 12301  
GE Report No. GE 5-71-1110 (09/1971).  
Availability: AD 888334

The development of a high-performance liquid-metal collector configuration for operation in high-intensity ambient magnetic fields is discussed. The influence of various design alternatives on collector performance is considered and a collector configuration is specified for further study in an experimental program. The results of a test program confirming the performance characteristics predicted in the theoretical studies is described. The development of liquid-metal collector systems for use in superconductive acyclic machines having multiple-disk rotor arrangements is presented. The characteristics of multiple-disk acyclic machines are reviewed and design factors for high-power-capacity machinery are developed. The results of tests on a 150-kilowatt generator are presented. The experiments correlated well with theoretical predictions, and the results of this program will permit the development of large superconductive direct-current machines with efficiencies of over 96 percent. 5 Refs.

Primary Keywords: Liquid Contact; High Intensity Magnetic Field; Performance Test; Experiment; Theory

5582  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
ELECTRICAL MEASUREMENT OF HIGH VOLTAGE PULSES IN DIAGNOSTIC X-RAY UNITS  
R.E. Hebner Jr.  
National Bureau of Standards, Washington, DC  
Interim report Mar 76-Sep 75 No. NBSIR-75-775, 62p (11/1975).  
Availability: PB-248 684/35T

NTIS

The report describes a method of calibrating dividers used to measure high voltage pulses in diagnostic x-ray units. The experimental development emphasized four areas. These were the divider ratio under direct voltage, the frequency dependence of the ratio, the voltage dependence of the ratio and the effect of self-heating on the device. The results of measurements on approximately fifteen different dividers are summarized. In addition, this report contains two appendices. The first discusses conventional and electro-optical methods of measuring the high voltage pulses, while the second presents a more detailed analysis of the feasibility of electro-optical measurement of these pulses.

Primary Keywords: X Ray Apparatus; Electrical Measurement; High Voltage; Diagnosis; Medical Equipment; Electrooptics; Kerr Electrooptical Effect; Pulsation  
Secondary Keywords: Diagnostic Equipment; NTISCOMBDS; NTISFDBRHM

5583  
(SWITCHES, OPENING)  
(Superconductive)  
EXPERIMENTAL RESULTS WITH SC/NC BREAKERS  
W. Amenda, M. Pillsticker and M. Seel

Institut für Plasmaphysik, Garching, FRG  
No. IPP-4/128, 51p (01/1975).  
Availability: NTIS 22465/85T

NTIS

The switching-off effect of a superconductive/normal conductive (SC/NC)-breaker (cryotron) is based on the increase of the resistance from 0 to a determined value, if the transition from the superconductive to the normal conductive state is triggered. The fast commutation of a current from one branch of a network to another can be started by the switching-off effect of a SC/NC-breaker. Results of several tests with SC/NC-breakers suitable for high currents up to 800 A are reported. The relation between the switching time or the commutation time and the rise time of the trigger current pulse, the energy of the pulse, the direct current of the breaker before triggering and a few other electrical parameters are determined experimentally. The demonstration that during commutation an intrusion of electrical energy from the trigger-pulse-circuit into the main circuit never can be compensated completely is an important result of the measurements. (Author)

Primary Keywords: Circuit Breakers; Superconductors; Switching Circuits; Electrical Resistance; Network Analysis; Niobium; Titanium; Trigger Circuits; Wire  
Secondary Keywords: West Germany; NTISNASAE

5585  
(SWITCHES, CLOSING)  
(Systems)  
HERTZIAN ARRAY SWITCH INVESTIGATION  
J.M. Froud, D.H. Baird and W.H. McNeill

GTE Labs Inc., Waltham, MA 02154  
RADC Report No. RADC-TR-76-301 (10/1976).  
Availability: RADC-TR-76-301

An investigation of fast, high power switching with jitter in the subnanosecond time domain is reported. Methods involving field distortion triggering in high pressure gases, photoconduction triggering in aprotic liquids and opto-electronic triggered in solid semiconductors have been investigated. The most promising avenue for further research is identified in the latter area where extremely small jitter and rapid turn-on capabilities are well matched to the timing requirements in Hertzian arrays. 20 Refs.

Primary Keywords: Hertzian Array; Spark Gap; Field Distortion Triggering; Photoconduction Triggering; Subnanosecond Jitter; Gas Gap; Aprotic Liquid Gap

5588  
(POWER TRANSMISSION)  
(Cables)  
HIGH VOLTAGE CABLE SPLICING AND CABLE TERMINATION TECHNIQUES  
D.E. Meems  
Naval Civil Engineering Lab, Port Hueneme, CA  
Final rept. Jul 74-Dec 75 No. CEL-TN-1452, 22p (08/1974).  
Availability: AD-A030 872/65T  
NTIS

The splicing and termination of underground electrical distribution cable requires that the integrity of cable conductor and insulation be maintained throughout its length. A large number of commercial cable splice and termination kits are available which are claimed to fulfill these requirements. The Civil Engineering Laboratory (CEL) was requested to investigate the suitability of these kits for use at Naval shore facilities. Of special interest were the slip-on cable splice and cable termination for solid dielectric insulated cable. These slip-on devices proved to be the easiest and fastest to install with good reproducibility, and the electrical characteristics were as good as, or better than, the other types of cable splice and cable termination kits tested. (Author)  
Primary Keywords: Electric Cables; Splices; Electric Terminals; Underwater Equipment; Underground; Coaxial Cables; Couplings; Electric Power Distribution; High Voltage; Electric Power; Commercial Equipment; Kits; Dielectric Properties; Electrical Insulation  
Secondary Keywords: NTISDODXA

5590  
(ENERGY STORAGE, MECHANICAL)  
(Rotating Machines)  
MECHANICAL TANGENT STRESSES IN THE ROTOR DISC OF THE SHOCK-EXCITED HOMOPOLAR GENERATOR AT ITS BRAKING  
Y.V. Spirchenko  
Mashinostroyenijskij Inst. Elektrofizicheskoy Apparatury, Leningrad (USSR).  
Availability: NP-20375  
NTIS  
Formulas for determining the mechanical tangential stresses in the rotor disc of the homopolar generator with a liquid-metal circular contact at braking in shock-excited conditions are obtained. The particular cases are considered: a constant thickness disc and a conical one.  
Primary Keywords: Electric Generators; Rotors; Rotors; Stresses; Brakes; Liquid Metals; Stress Analysis  
Secondary Keywords: ERDA/20200; NTISERDA  
Distribution Restriction: U.S. Sales Only.

5591  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
MULTICHANNEL SPARK-GAP TECHNOLOGY FOR STAGED THETA-PINCH MACHINES  
M.W. Borkenheagen, R.F. Gribble, L.D. Hansborough, R.K. Linford and J.G. Melton  
Los Alamos National Labs, Los Alamos, NM 87545  
No. CONF-751125-48, 3p (08/1976).  
Availability: LA-UR-75-2152  
NTIS  
Triggered multichannel switches operating at voltages up to 180 kV with inductances of 10 to 15 nH have been developed for the staged theta-pinch machines at LASL. These multichannel devices, depending upon their design, can switch up to 30 kJ per switch with peak currents up to 1 MA. The designs of the various spark-gap configurations are discussed from a mechanical and an electrical viewpoint. The switching modes including crowbar, high-voltage start, and high-voltage holdoff low-voltage start, as well as the experimentally determined triggering characteristics, are also discussed.  
Primary Keywords: Linear Theta Pinch Devices; Switches; Power Supplies; Spark Gaps; Design  
Secondary Keywords: NTISERDA

5592  
N/SUB 2/-SF/SUB 6/ GAS MIXTURE AS INSULATION MATERIAL FOR HIGH VOLTAGE TECHNOLOGY  
M. Ernel  
(01/1975).  
Availability: ORNL-tr-4182  
NTIS

Breakdown strength in the uniform and nonuniform field, vapor pressure curves and chemical stability under spark discharges are examined. Modifications are made to the theory of breakdown in gas mixtures. The investigation of breakdown characteristics leads to a general statement about the electric strength of the N sub 2 -SF sub 6 -mixture. Even an important reduction of SF sub 6 -content causes only low loss of strength compared to SF sub 6 , at the same time preventing SF sub 6 -condensation in a wider range. Altogether the mixture shows some advantages compared to SF sub 6 . As a result of the theoretical considerations modified ionization coefficients for gas mixtures are introduced and explained for the N sub 2 -SF sub 6 -mixture. (ERA citation 01-025717)  
Primary Keywords: HVAC Systems; Nitrogen; Sulfur Fluorides; Breakdown; Dielectric Properties; Electrical Insulation; Gas-insulated Cables; Gases; Mixtures  
Secondary Keywords: ERDA/200301; Translations; West Germany; Dielectric Breakdown; NTISERDA  
Distribution Restriction: TRANSLATED BY E.G. SILVER FROM INSULATION MATERIAL FOR HIGH VOLTAGE TECHNOLOGY, ELEKTROTECH. Z., A 96 N5 P231-235 1975

5593  
(PARTICLE BEAMS, ELECTRON)  
(Transport)  
ON THE PROPAGATION OF HIGH INTENSITY, HIGH VOLTAGE ELECTRON BEAMS AND THE MAXIMUM CURRENT WHICH SUCH BEAMS MAY POSSESS  
T.G. Roberts  
Army Missile Command, Redstone Arsenal, AL 35809  
Technical rept. No. RR-TR-69-7, 27p (06/1969).  
Availability: AD-857 607/65T  
NTIS

The existing theories for the propagation of intense electron beams at relativistic energies and the experimental results so far obtained are reviewed. A phenomenological description of beam propagation is given and an expression for the maximum current that a beam may possess is derived. This expression is somewhat different from the Alfven limit but reduces to this limit in the case of a fully neutralized beam. (Author)  
Primary Keywords: Electron Beams; Propagation; Relativity Theory; Electric Currents; Drift; Focusing; Cosmic Rays  
Secondary Keywords: NTISDOD4D  
Distribution Restriction: Distribution limitation now removed.

5594  
(SWITCHES, CLOSING)  
(Reviews)  
R AND D RECOMMENDATIONS FOR FUTURE ERDA SWITCH REQUIREMENTS  
D.S. Zucker  
Lawrence Livermore Lab, Livermore, CA 94550  
No. CONF-760334-2, 8p (04/1976).  
Availability: UCRL-78112  
NTIS

The following switches are briefly discussed: (1) high pressure and vacuum spark gaps, (2) liquid dielectric gaps, (3) solid dielectrics, (4) nonlinear ferromagnetic materials, (5) semiconductors, superconductors, (6) ferroelectric switches, (7) exploding wires, and (8) plasma instabilities. (ERA citation 01-018359)  
Primary Keywords: Switches; Dielectric Materials; Planning; Power Supplies; Research Programs; Spark Gaps; Thermodynamic Reactors  
Secondary Keywords: ERDA/700209; NTISERDA

5597  
(ELECTROMAGNETIC COMPATIBILITY)  
(Transient Suppressors)  
TEST PROCEDURES FOR EVALUATING TERMINAL PROTECTION DEVICES USED IN EMP APPLICATIONS  
R.L.J. Williams  
Harry Diamond Labs, Washington, DC 20438  
Technical rept. No. HDL-TR-1709, 84p (06/1975).  
Availability: AD-A019 098/35T  
NTIS

Certain commercially available components were tested to establish test procedures for characterizing terminal protection devices used in electromagnetic-pulse (EMP) applications. The devices tested include spark gaps, filters, avalanche diodes, and various other nonlinear components. Square pulses of 50- and 500-nsec duration and up to 11 kV in amplitude, with rise times of 2 to 4 nsec, were applied to the devices. Response time and energy leakage were recorded for each test. Insertion loss and approximate failure level were measured for each device. Results are presented in tabular form. The devices that appear suitable for terminal protection include spark gaps, some filters, and some semiconductor devices with breakdown voltage less than about 50.  
Primary Keywords: Suppressors; Electromagnetic Pulses; Surges; Transients; Spark Gaps; Electromagnetic Wave Filters; Semiconductor Devices; Test Methods; Electronic Equipment; Protection  
Secondary Keywords: Terminal Protection Devices; NTISDOD4

5601  
(PARTICLE BEAM, ION)  
(Generation)  
BEAM OPTICS FOR ION EXTRACTION WITH A HIGH-VOLTAGE-RATIO ACCELERATION-DECELERATION SYSTEM  
T.S. Green  
Culham Lab, Abingdon, Oxfordshire, UK  
Journal Of Physics D: Applied Physics, Vol. 9, No. 7, pp 1165-1171 (05/1976).  
7 Refs.

Primary Keywords: Ion Beam Perveance; Two Stage Extraction; Beam Optics; Multiple-lens Model; Zero Divergence Beam; Beam Magnification  
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5602  
(ENERGY STORAGE, MECHANICAL; ENERGY STORAGE, INDUCTIVE)  
(Rotating Machines; Systems)  
ANALYSIS OF HOMOPOLAR GENERATORS AND SUPERCONDUCTING INDUCTIVE ENERGY STORAGE SYSTEMS AS POWER SUPPLIES FOR HIGH-ENERGY, SPACE-BASED LASERS  
J.S. Gilbert and E.A. Kern  
Los Alamos National Labs, Los Alamos, NM 87545  
(02/1975).  
Availability: LA-5837-MS  
NTIS

For abstract, see ERA 75 02, number 00231.  
Primary Keywords: Energy Storage; Electric Generators; Flywheels; Induction; Lasers; Power Supplies; Superconducting Magnets  
Secondary Keywords: ERDA/250100; NTISERDA

5603  
(EXPANSION STUDIES)  
(Gas, Electrical)  
BREAKDOWN AND PLASMA FORMATION IN A ROTATING PLASMA DEVICE  
B. Bonnevier and A.M. Sillescu  
Royal Institute of Technology, Stockholm, Sweden  
No. TRITA-EPP-74-06, 17p (03/1974).  
Availability: N74-26196/7  
NTIS

Breakdown and formation of a plasma with high ion temperature were studied in the Puffatron at Risø. The conditions for plasma formation are along the same lines as breakdown in an ordinary crossed field discharge such as Penning, PIG, or magnetron discharge, where ions are not magnetically confined, as in the present experiment. The growth of ionization occurs much faster than expected from ionization by thermal electrons. This has been seen in some earlier rotating plasma experiments. It is suggested that work along the present lines can result in a time independent arc discharge, where ions have thermonuclear energies. (Author)  
Primary Keywords: Arc Discharges; Critical Velocity; Crossed Fields; Plasma Heating; Thermonuclear Power Generation; Direct Power Generators; Energy Conversion; Energy Transfer; High Voltages; Ion Motion; Ionization; Magnetically Trapped Particles; Plasma Control  
Secondary Keywords: NTISNASHA

5604  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Electrodes; Gas Gaps, Materials)  
CASTING COPPER TO TUNGSTEN FOR HIGH POWER ARC LAMP CATHODES  
M.A. Mill  
Lewis Research Center, Cleveland, OH  
No. NASA-TN-X-2845, 11p (08/1973).  
Availability: NTIS-27451/6  
NTIS

A method for making 400-kW arc lamp cathodes is described. The cathodes are made by casting a 1.75-in. diameter copper body onto a thoriated tungsten insert. The addition of 0.5-percent nickel to the copper prevents voids from forming at the copper-tungsten interface. Cathodes made by this process have withstood more than 110 hours of operation in a 400-kW arc lamp. (Author)

Primary Keywords: Arc Lamps; Cathodes; Copper Alloys; Refractory Metal Alloys; Tungsten Alloys; Equipment Specifications; Manufacturing; Product Development; Service Life  
Secondary Keywords: NASA

5605  
(ELECTROMAGNETIC COMPATIBILITY)  
(Transient Suppressors)  
CHARACTERIZATION OF EMP PROTECTION DEVICES  
G.G. Davidson and E.T. Hunter  
ECOM, Fort Monmouth, NJ 07703  
Technical rept. No. ECOM-4128, 53p (07/1973).  
Availability: AD-763 886  
NTIS

Since late 1969, a technique based on time domain reflectometry (TDR) to measure the fast switching and shunting capability of EMP protective devices has been used. This technique allows the devices to be characterized in their actual working condition--inserted in the cable line--without the perturbing influence of voltage and current probes. The report starts with the basic line theory and develops an understanding of the effect of shunt devices and the measurement of such effects using TDR. This section is fairly lengthy; however, a good background is essential for the understanding of measurements made with this technique. In addition to the measurement technique itself, a special pulse generator was developed to provide the necessary pulse into 50 ohm lines. This pulse source is described along with the basic measurement procedure. Specific techniques and data are shown for a variety of shunt protective devices. (Author)

Primary Keywords: Suppressors; Electromagnetic Pulses; Switching Circuits; Nuclear Explosions; Avalanche Diodes; Silicon Controlled Rectifiers; Electric Discharges; Neon; Measurement  
Secondary Keywords: Bypasses; Spark Gaps; A

5609  
(ENERGY STORAGE, CAPACITIVE; SWITCHES, CLOSING)  
(Capacitor Banks; Gas Gaps, Electrical)  
CONTROL OF HIGH ENERGY CAPACITOR BANKS  
M. Sugiura, M. Ikeda, M. Iguchi and S. Takeda  
Electrotechnical Lab, Tokyo, Japan  
No. RR-713, 116p (01/1971).  
Availability: NTIS-13200  
NTIS

Primary Keywords: Capacitors; Electric Equipment; Electrical Properties; Trigger Circuits; Electric Equipment Tests; Equipment Specifications; Spark Gaps

5611  
DESIGN AND CONSTRUCTION OF A SPARK GAP ASSEMBLY AND ASSOCIATED CIRCUITS  
L. Hubbeling  
CERN, Geneva, Switzerland  
(04/1972).  
Availability: CERN-72-6  
NTIS

For abstract, see NSA 26 18, number 43103.  
Primary Keywords: Pulse Generators; ELECTRONICS; Radiation Detectors; Spark Chamber  
Distribution Restriction: U. S. SALES ONLY

5612  
(INSULATION, MATERIAL)  
( )  
EFFECTS OF COATING AND CLEANING ON CORONA AND HIGH-VOLTAGE BREAKDOWN IN ELECTRONIC ASSEMBLIES  
E.R. Brown  
Bendix Corp, Kansas City, MO  
(02/1975).  
Availability: BDX-613-1181(Rev.)  
NTIS

For abstract, see NSA 31 10, number 28928.  
Primary Keywords: Dielectric Materials; Protective Coatings; Corona Discharges; Protective Coatings; Cleaning; Failures; Surface Contamination  
Secondary Keywords: NTISERDA

5614  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
ELECTRICAL AND PHOTOGRAPHIC CHARACTERIZATION OF LOW-INTENSITY CAPACITOR SPARK DISCHARGES  
C.R. Westgate, M.S. Kirshenbaum and B.D. Pollock  
Picatinny Arsenal, Dover, NJ  
Technical rept. No. PA-TR-4737, 36p (02/1975).  
Availability: AD-A008 356/851  
NTIS

Some properties of the gaseous discharges normally used in electrostatic initiation of primary explosives are determined from electrical and photographic studies. It is shown that the magnitude of the postbreakdown current can determine the form of the discharge. For currents larger than about 0.3 amp, the discharge is essentially an arc characterized by a low (15-30 v) voltage drop across the gap. For currents less than 0.1 amp, the discharge is essentially a spark or glow discharge characterized by a voltage drop of approximately 380 volts across the gap. In both cases, the voltages and the transition current are only slightly affected by variations in the gap length.

Primary Keywords: Explosives; Electric Ignition; Spark Ignition; Electrostatic Charge; Electric Igniters; Spark Gaps; Glow Discharges; Photographic Analysis  
Secondary Keywords: NTIS000A

5616  
(ELECTROMAGNETIC COMPATIBILITY)  
(Lightning)  
FAA LIGHTNING PROTECTION STUDY: LIGHTNING PROTECTION DEVICES  
C. Chen  
RADC, Griffiss AFB, NY 13440  
Final rept. Nov 72-31 Jan 74 (04/1974).  
Availability: AD-781 319/9  
NTIS

The purpose of the Lightning Protection Study is to determine the degree of susceptibility of the Federal Aviation Administration electronic systems to induced electromagnetic pulse effects due to lightning, and to propose protective devices adequate for low voltage electronic systems. This report covers one phase of the study; the lightning protective devices. The other study phases are reported in separate reports, namely lightning simulation tests of communication cables, analytical study of cable coupling, cable terminal equipment susceptibility levels. The report consists of five chapters on introductory remarks and definition of terms, gas discharge transient protectors, semiconductor breakdown diodes, metal-oxide varistors, and deployment and retrofit of protective devices. (Author)

Primary Keywords: Lightning Arresters; Communication Equipment; Electronic Equipment; Air Traffic Control Systems; Protective Equipment; Gas Discharges; Avalanche Diodes; Semiconductor Breakdown Devices; Transients; Suppression  
Secondary Keywords: NTISDOT; Varistors; Spark Gaps; NTISDDFAA

5619  
(PARTICLE BEAMS, ION)  
(Generation)  
HIGH POWER ELECTROSTATIC ION ACCELERATORS  
S.J. Humphries  
Cornell University, Ithaca, NY 14850  
(10/1973).  
Availability: LPS-136  
NTIS

For abstract, see NSA 29 05, number 10806.  
Primary Keywords: Electrostatic Accelerators; Operation; Field Emission; Ion Beams; Ion Sources; Kev Range 100-1000; Kilo Amp Beam Currents; Max Range 01-10; Planning; Plasma  
Secondary Keywords: AEC

5620  
(PULSE GENERATORS; SWITCHES, CLOSING)  
(Line Type; Thyristors)  
HIGH POWER MODULATOR TECHNIQUES (SCR)  
R.A. Smith  
Westinghouse Electric Corp, Baltimore, MD Surface Div.  
Final rept. 28 Nov 67-30 Jul 68 (11/1968).  
Availability: AD-845 111  
NTIS

Development and test of a 65KV Silicon Controlled Rectifier demonstrates the application of solid state devices and their inherent reliability in high power pulse modulator techniques. The design exploits the high voltage and high current capabilities of the SCR. Eighty devices in series yield a minimum holdoff voltage of 65KV; the test modulator switches pulse currents of 375 amperes although the SCRs have a 1000 ampere minimum peak pulse current capability. The 65KV SCR switch assembly employs a building block concept utilizing ten, 6.5KV SCR switch assemblies. (Author)  
Primary Keywords: Modulators; Silicon Controlled Rectifiers; Silicon Controlled Rectifiers; Electronic Switches; Trigger Circuits; Flash Lamps; Xenon; Saturable Reactors; Control Panels

5622  
(SWITCHES, OPENING)  
(Vacuum Gaps, Electrical)  
HIGH-VOLTAGE ARC INTERRUPTION STUDY  
A.S.L.D.L. Gilmour  
Senders Associates Inc, Nashua, NH  
Final rept. Dec 70-Dec 71 (04/1972).  
Availability: AD 764 836  
NTIS

In 1968 it was observed by the authors that an axial magnetic field applied to a vacuum-arc discharge in a coaxial diode was capable of extinguishing the discharge. A continuing effort to develop a high-voltage dc arc interrupter has resulted in a device capable of interrupting 500 amperes at 15 kilovolts. This device has been operated at repetition frequencies of several pulses per second. Over 300 pulses per second have been achieved at low power levels. The turn-on and turn-off times are, respectively, one and two microseconds. The pulse width is variable from about two to several hundred microseconds. Operation at voltages above 15 kilovolts has been prevented, primarily, by anode spots. With improved materials and vacuum techniques and modified geometries, operating voltages far above 15 kv should be possible. One of the uses for the interrupter is expected to be in high-power modulators. (Author)

Primary Keywords: Electric Switches; Electric Arcs; Electric Arcs; Reduction; Vacuum Apparatus; Magnetic Fields; Plasma Generators  
Secondary Keywords: Interrupters

5623  
(BREAKDOWN STUDIES)  
(Corona)  
INVESTIGATION OF CORONA DISCHARGE DEVICES AS ELECTRICAL LOADS FOR EXPERIMENTAL HIGH-VOLTAGE GENERATORS  
K.K. Joshi and T.H. Maloney  
Systems Research Labs Inc, Dayton, OH  
(06/1971).  
Availability: AD-748 935  
NTIS

The use of the corona discharge mechanism as a means of providing an electrical load for experimental high-voltage low-current dc generators is investigated. The current-voltage characteristics of several corona discharge configurations, such as point-to-plane, coaxial cylindrical, and wire-to-plane, were experimentally obtained and compared with theoretically predicted values. Of all the configurations tested, the wire-to-plane configuration is found to be capable of dissipating the maximum electrical power (nearly 3 KW/m length of wire) and exhibits a wide range of current-voltage characteristics of various pressures, depending largely upon the wire-to-plane spacing. (Author)

Primary Keywords: Generators; Electrical Corona; Direct Current  
Secondary Keywords: Loading; (Electrical)  
Distribution Restriction: Availability: Pub. in IEEE Transactions on Electron Devices, vED18 n12 p1163-1166 Dec 71

5624  
(PULSE GENERATORS)  
(Trigger)  
INVESTIGATIONS ON HIGH VOLTAGE PULSERS AND AMPLIFIERS FOR THE EXACT  
TIMING OF THE IGNITION OF SPARK DISCHARGERS  
M. Pillitter, Technische Universität, Brunswick (West Germany), Institut für  
Hochspannungstechnik,  
(12/1971).  
Availability: BMBF-FBK-71-22  
NTIS  
For abstract, see NSA 26 18, number 24548.  
Primary Keywords: Electric Arcs

5625  
(BREAKDOWN STUDIES)  
(Gas, Recovery)  
INVESTIGATIONS ON THE INTERACTION BETWEEN ARCS AND GAS FLOW  
K. Zueckler, M. Topplin, M. Neeske, R. Patzelt and K.P. Rolff  
Siemens-Werke, Berlin, FRG  
No. BMT-FB-T-73-89, 75p (07/1973).  
Availability: W74-11552/8  
NTIS  
Model circuit breaker experiments were carried out to investigate  
the relationship between gas flow and arc behavior in the current  
zero-region. Synthetic circuits were set for the electrical tests.  
The optical investigations were carried out by the aid of a  
schlieren-apparatus with a high speed camera. The existence of plasma  
jets, which carry metal particles in the region between the contacts,  
was demonstrated. The behavior of the insulation material in the  
proximity of the arc was investigated and a suitable test method was  
worked out. It was possible to improve the mathematical description  
of the dynamic arc-behavior by a completion of the equation of Mayr.  
(Author)  
Primary Keywords: Circuit Breakers; Electric Arcs; Gas Cooling; High  
Speed Cameras; Schlieren Photography; Extinguishing;  
Gas Flow; High Voltages; Metal Particles; Plasma  
Jets; Quenching (Cooling)  
Secondary Keywords: NASA

5630  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
MECHANISM WHICH LEADS TO THE FORMATION OF AN ELECTRIC SPARK AT VERY  
HIGH VOLTAGE AND UNDER ULTRA-VACUUM FOR THE MEASUREMENT OF THE DELAY  
TIME OF THE DISRUPTION  
F. Rohrbach  
CERN, Geneva, Switzerland  
(10/1971).  
Availability: CERN-71-28  
NTIS  
For abstract, see NSA 26 09, number 22469.  
Primary Keywords: Electric Arcs

5631  
(PARTICLE BEAMS, ION)  
(Generation)  
THE USE OF FINITE J/SUB THETA/ FOR INCREASING THE ION EFFICIENCY OF  
HIGH IMPEDANCE DIODES  
R.J. Barker and S.A. Goldstein  
Naval Research Lab, Washington, DC 20375  
NRI Memorandum Report No. 4773, 45p (04/1982).  
Availability: NTIS  
Numerical simulations predict that the ratio of the effective ion  
current to total diode current can be significantly increased by  
introducing a small but finite azimuthal current into the tip of the  
cathode sheath of a high impedance (4 ohm) axial pinch-reflex diode.  
Such a current generates large tangential magnetic fields along the  
electron-emitting cathode surfaces. These fields, in turn, impart a  
finite angular momentum to the electrons as they are injected into  
the anode-cathode gap. The resultant particle self-fields alter  
electron trajectories in such a way as to boost electron space charge  
near certain portions of the ion-emitting anode surface. The net  
consequence is a modification of the radial profile of ion emission  
which enhances the net ion current transmitted through the interior  
of the hollow cathode sheath. 31 Refs.  
Primary Keywords: Ion Beam Generation; Magnetic Insulation;  
Pinch-reflex Diode; Theory; Numerical Simulation

5634  
PHOTOCONDUCTIVITY OF HIGH-VOLTAGE SPACE INSULATING MATERIALS  
H.T. Coffey, J.E. Nanevich and R.C. Adamo  
Stanford Research Institute, Menlo Park, CA 94025  
Final Report, 1 Jul. 1974 - 1 Oct. 1975. No. NASA-CR-134995, 67p  
(01/1975).  
Availability: N76-19233/55T  
NTIS  
The dark and photoconductivities of four high voltage spacecraft  
insulators, Kapton-M, FEP Teflon, Parylene, and fused quartz, were  
studied under a variety of conditions intended to simulate a space  
environment. All measurements were made in a vacuum of less than  
10001 torr while the temperature was varied from 22 C to 100 C. Some  
of the samples used employed conventional deposited metal  
electrodes-others employed electrodes composed either of an electron  
beam or a plasma formed by ionization of the residual gas in the test  
chamber. Test results show: (1) Kapton had unusual conduction  
properties; its conductivity decreased by more than an order of  
magnitude when heated at 100 C in a vacuum, but ultimately attained a  
stable and reproducible value. (2) Both Teflon and fused quartz had  
high dark resistivities but low photoresistivities when exposed to  
UV. Optical-density measurements revealed that both materials  
transmitted UV with little attenuation. (3) Parylene was found to  
have a low but relatively stable resistivity-comparatively minor  
changes occurred upon heating or illuminating the sample.  
Optical-density measurements showed that Parylene was absorbent in  
the UV and would prevent photoemission from the metal electrode on  
the back surface. (Author)  
Primary Keywords: Electrical Insulation; Materials Tests;  
Photoconductivity; Spacecraft; High Voltages;  
Environment Simulation; Quartz; Teflon (Trademark)  
Secondary Keywords: Polyimide Resins; Kapton; Tetrafluoroethylene  
Resins; Parylene Polymers;  
Poly(methylene-phenylene-methylene); NTISNASA

5635  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
PORTABLE KERR SYSTEM FOR THE MEASUREMENT OF HIGH VOLTAGE PULSES  
R.E.J. Hebner and S.R. Booker  
Sandia Labs, Albuquerque, NM 87115  
No. CONF-750405-1, 5p (01/1975).  
Availability: SAND-75-5132  
NTIS  
For abstract, see NSA 31 12, number 35721.  
Primary Keywords: Pulse Measuring Methods; Optical Systems; Kerr  
Effect; Laser Radiation; Mirrors; Oscillographs;  
Photodetectors; Polarization; Pulse Rise Time  
Secondary Keywords: NTISERDA

5636  
(POWER CONDITIONING)  
(Pulse Transformers)  
POWER PULSE TRANSFORMER  
O.S. Bogdanov, Y.P. Vakhrushin, V.G. Zhitenov, N.I. Kolesov and A.V.  
Orlov  
Scientific-Research Institute Of Electro-Physical Apparatus, Leningrad,  
USSR.  
Availability: NP-19092  
NTIS  
For abstract, see NSA 26 05, number 10678.  
Primary Keywords: Electron Sources; Linear Accelerators; Transformers

5638  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
QUANTITATIVE MEASUREMENTS OF THE EMISSION FROM HIGH DENSITY NANOSECOND  
SPARK CHANNELS  
H.S.W. Fischer  
Angewandte Physik, Technische Hochschule Darmstadt, Darmstadt, FRG  
Interim scientific rept. no. 2, 1 Feb 70-31 Jan 71 (12/1971).  
Availability: AD-759 255  
NTIS  
Quantitative values of the luminance and radiance at 4950 Angstrom  
were measured for Nanolite spark channels in the nanosecond range.  
The comparison standard was a crater of a low current carbon arc.  
Data of the Nanolite were: Capacitance, 1.35 nanofarads; Inductance,  
2.1 microhenrys; Breakdown Voltage, 3.2 kilovolts; Gap, 0.65 mm;  
Pressure, 1 atmosphere. The maximum luminance was 20.0 units per  
centimeter squared steradian Angstrom plus or minus 20 percent. The  
maximum radiance (at 4950 Angstrom) was 12.6 times ten to the sixth  
candlepower per centimeter squared, plus or minus 20 percent.  
Earlier observations demonstrated that the opacity in 1 atmosphere  
air during the current maximum is greater than 8.8. This opacity  
value is used to calculate the radiation temperature which was 31000  
degrees Kelvin. Scaling laws are being derived for comparison with  
earlier observations in literature. These results compare rather  
well in spite of considerable simplifications used in the  
calculations. (Author)  
Primary Keywords: Electric Discharges; Light Pulses; Luminescence; Gas  
Discharges; Electric Arcs; Spectra (Visible +  
Ultraviolet)  
Secondary Keywords: Spark Gaps

5640  
(SWITCHES, OPENING)  
(Superconductive)  
SUPERCONDUCTING SWITCH WITH IMPULSE CURRENT TRIGGERING  
H. Koefler  
Institut für Experimentelle Kernphysik, Karlsruhe, FRG  
No. KFK-2123, 24p (08/1975).  
Availability: N76-25667/65T  
NTIS  
Supplying reactive power by superconducting storage systems may  
have considerable advantages. The behavior and parameters of the  
switching device, and opening and closing the storage circuit were  
studied. Approximate mathematical solutions were checked against  
measured results. The influence of the impulse capacitor was studied  
and hints to design the triggering circuits are given. (Author)  
Primary Keywords: Actuators; Superconductors; Switches; Capacitors;  
Energy Storage; Trigger Circuits  
Secondary Keywords: West Germany; NTISNASA  
Distribution Restriction: In German; English Summary.

5642  
(PULSE GENERATORS)  
(LC)  
DRIVING CIRCUITS FOR COPPER HALIDE LASERS - A PARAMETRIC STUDY  
A.J. Andrews, R.C. Tobin and C.E. Webb  
Clarendon Lab, Oxford, UK  
Journal Of Physics D: Applied Physics, Vol 13, No. 6, pp 1017-1027  
(06/1980).  
13 Refs.  
Primary Keywords: Double Spark Gap; Thyatron Burst Mode Drivers;  
Circuit Inductance; Current Rise-time; Laser  
Performance  
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5644  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
INFLUENCE OF STATISTICAL TIME LAGS UPON ELECTRIC BREAKDOWN IN  
ELECTRONEGATIVE GASES

R.M. Crowe  
Franklin GND Corp, West Palm Beach, FL  
Journal Of Applied Physics, Vol. 37, No. 4, pp 1515-1527 (03/1966).  
Measurement of the electric strength of SF/sub 6/ and a number of other electronegative gases has provided direct evidence that an unusually long statistical time lag is associated with the breakdown process in such gases under certain experimental conditions. For example, time lags in excess of one minute have been reported for the breakdown of SF/sub 6/. The reason for the difference in breakdown behavior of such gases, when compared with the behavior of the more common gases, is not well understood. The paper represents an attempt to provide an explanation of the role that these statistical time lags can often play in yielding misleading experimental values of the electric breakdown voltage, when measured under certain standard test conditions. A number of cases are discussed and evaluated by combining accurate experimental data with theories involving the occurrence of random events. It is concluded that the 'apparent' value of the electric breakdown voltage in electronegative gases ought to be strongly dependent upon the mean statistical time lag, the nature of voltage application, and the electrode configuration. The experimentally observed appearance of field emission from the cathode surface at voltages considerably in excess of the threshold value, can be used to derive theoretical relationships which indicate that rather significant 'apparent' deviations from Paschen's law are to be expected under certain experimental conditions. 9 Refs.

Primary Keywords: Statistical Time Lag; Electronegative Gas; Several Gases; Breakdown Voltage Error; Paschen's Law  
Deviation; Experiment; Theory  
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5646  
(PULSE GENERATORS)  
(Mech)  
TRANSIENT PHENOMENA IN THE MARX-TYPE MULTIPLIER CIRCUIT AFTER FIRING  
THE FIRST SWITCHING SPARK GAP

A. Rodewald  
National Research Council, Ottawa, Ontario, Canada  
No. MRC-TT-1516, 28p (01/1972).  
Availability: N72-18236  
NTIS  
The transient processes after the firing of the first switching spark gap in the Marx-type multiplier circuit are investigated experimentally. The test results are described in terms of a simple equivalent diagram. The equivalent diagram comprises a series of resistances with longitudinal and transverse capacitance. The series of resistances is formed by the resistances inserted between the individual generator stages. The so-called discharge resistances here play the principal part. The longitudinal and transverse capacitances in the circuit are provided by the stray capacitances between the neighbouring generator stages and the stray capacitances of the generator stages relative to earth. The generally capacitive loading of the generator in the case of the observed rapid transient processes acts as a short circuit at the output of the series. The longitudinal voltages in the individual stages of the series appear as overvoltages at the corresponding switching spark gaps. The firing of a switching spark gap as the result of such an over voltage is oscillographed. (Author)  
Primary Keywords: Multiplexing; Spark Gaps; Transient Response; Circuit Diagrams; Electric Potentials; Fire Control Circuits

5647  
(BREAKDOWN STUDIES)  
(Equipment)  
TRANSPORT PROPERTIES IN HIGH POWER ARCS  
M.H. Maecker  
Technische Universität Munich (West Germany) Elektrophysikalisches Institut  
Final rept. 1 Feb 67-31 Jan 71 (05/1972).  
Availability: AD-744 518  
NTIS

In order to investigate transport and radiation properties of various plasmas the cascade arc chamber was improved with respect to new electrodes, to pressure proof, and to air-cooled plates for low power input and was made fit for viscosity measurements by providing a honeycomb flow rectifier and pressure taps along the cascade. The temperature distribution across the M2 - arc has been re-examined by all methods available with high precision. The splitting of the heat flux potential curves vs. temperature at low currents in the M2 arc could be removed by reducing the electron temperature to the gas temperature taking into account inelastic collisions between electrons and M2 - molecules. In the Arc-arc radiation plays a dominant role and changes rapidly with elevated pressures. Therefore extended measurements of all quantities of interest have been carried out at temperatures up to 25,000K and in the pressure range from 1 to 10 atms.  
Primary Keywords: Gas Discharges; Transport Properties; Gas Ionization; Laminar Flow; Hydrogen; Oxygen; Nitrogen; Electrical Conductance; Thermal Conductivity; West Germany  
Secondary Keywords: Plasma Diagnostics; Electron Energy; Hydrogen Plasma; Nitrogen Plasma; Argon Plasma

5648  
(SWITCHES, CLOSING; SWITCHES, OPENING)  
(Vacuum Tubes; Vacuum Tubes)  
TUBE FAILURE MECHANISMS  
K.G. Baughard and L.W.P. Lesensky  
Raytheon Co, Waltham, MA  
Final rept. 1 May 68-30 Sep 69 No. PT-2517, 98p (03/1970).  
Availability: AD-869 174  
NTIS

The investigation focused attention on (1) high voltage breakdown in vacuum as it occurs across vacuum gaps and along insulating surfaces and (2) surface studies of metal-oxide composite cathodes, as exemplified by the tungsten-thoria (W-ThO2) cermet cathode, pertaining to the chemical and topographical changes resulting from heat and electron bombardment. (Author)  
Primary Keywords: Electron Tubes; Failure (Electronics); Cathodes (Electron Tubes); Cermet; Copper; Surface Properties; Electric Discharges; Diffusion; Platinum; Tungsten; Titanium Alloys  
Secondary Keywords: High Voltage Breakdown

5649  
(PULSE GENERATORS)  
(Blumlein Lines)  
ELECTRICAL AND OPTICAL CHARACTERISTICS OF A MULTICHANNEL N/SUB 2/-LASER  
M. Mugenschmidt and J. Mey  
Deutsch-Französisches Forschungsinstitut, Saint Louis, France  
Optics Communications, Vol. 29, No. 2, pp 191-196 (05/1979).  
The influence of electrical parameters on the optical properties of atmospheric pressure transversely excited N/sub 2/ -lasers of the Blumlein-type is investigated. Experiments are performed using a multichannel laser system providing high repetition rate trains of nanosecond pulses (50 to 100 MHz). Both the high voltage rise and decay times of the order of several kV/ns are determined electro-optically and correlated with the intensity and time lag of the optical pulses. Using an injection technique the intensity and beam divergence could be markedly improved. 16 Refs.  
Primary Keywords: Blumlein Type Multichannel N/sub 2/ Laser; Electrical Properties; Optical Properties;  
Transverse Excitation  
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5651  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
CALIBRATION OF A FAR ULTRAVIOLET SPECTROGRAPH AND A STUDY OF VACUUM  
SPARK BREAKDOWN

T.M. Carpenter  
Oklahoma State University, Stillwater, OK  
No. NASA-CR-102643, 120p (05/1970).  
Availability: N70-26046  
NTIS  
Primary Keywords: Aluminum; Far Ultraviolet Radiation; Spark Gaps; Spectrometers; Emission Spectra; Plasma Temperature; Ruby Lasers; Spectrum Analysis

5652  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
CALIBRATION OF A KERR CELL SYSTEM FOR HIGH VOLTAGE PULSE MEASUREMENTS  
E.C. Cassidy and H.M. Cones  
Sandia Labs, Albuquerque, NM 87115  
Final rept. No. SC-CR-68-3730, 53p (08/1968).  
Availability: PB-180 864  
NTIS

The report summarizes progress made on the Kerr cell pulse measurements project. The following are included: (1) Systems for purification and testing of the nitrobenzene used in our Kerr cells were developed. (2) Methods for calibration of a Kerr system by reference to calibrated pulse divider measurements. These calibrations are believed to be accurate to better than 1%. (3) Methods for independent (without reference to pulse divider measurements), under both uniform and nonuniform field conditions, were developed and evaluated. (4) Pulse voltages as high as 100 kV were measured (simultaneously) by use of a calibrated pulse divider and a Kerr system. Several different Kerr cells were used. With further refinements, it is anticipated that such calibrations, accurate to within plus or minus 0.5% will be feasible for systems capable of time-resolved measurements of pulses as high as 300 kV.  
Primary Keywords: Shutters (Optics); Kerr Cells; Kerr Cells; Calibration; Electrostatic Fields; Birefringence; Polarization; Nitrobenzenes; Optical Equipment; Design; Pulse Systems; Lasers

5653  
(ENERGY STORAGE, CAPACITIVE)  
(Capacitor Banks)  
CAPACITOR BANKS FOR A TURBULENCE HEATING EXPERIMENT  
G. Herppich, A. Knobloch and G. Mueller  
Institut für Plasmaphysik, Garching, FRG  
No. IPP-4/50, 44p (06/1968).  
Availability: N68-32301  
NTIS

Primary Keywords: Capacitors; Electric Energy Storage; Turbulent Heat Transfer; Electric Potential; Ignition; Inductors; Ionization; Spark Gaps; Suppressors; Theta Pinch

5655  
(SWITCHES, CLOSING; SWITCHES, CLOSING)  
(Systems; Gas Gaps, Electrical)  
CROWBAR SYSTEM IN ISAR 1  
E. Van Mark and M. Medler  
Institut für Plasmaphysik, Garching, FRG  
No. IPP-4/59, 29p (06/1968).  
Availability: N68-32534  
NTIS

Primary Keywords: Capacitors; Plasma Generators; Spark Gaps; Arc Generators; Electric Discharges; Magnetic Fields; Short Circuits; Systems Engineering; Trigonons

5656  
(POWER CONDITIONING)  
(Cable Terminations)  
DAMPING OF VOLTAGE REFLECTIONS AT OPEN CIRCUIT ENDS OF CHARGED CABLES  
H.-. Schneider-munteau  
European Space Research Inst, Frascati, Italy  
(01/1969).  
Availability: N69-35146  
NTIS

Primary Keywords: Capacitance; Electric Pulses; High Voltages; Transmission Lines; Damping; Electrical Resistance; Numerical Analysis; Reflected Waves

5657  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
DESIGN AND ANALYSIS OF A STATISTICAL EXPERIMENT ON HIGH VOLTAGE  
M.M. Chrepta, M.H. Zinn and G.W. Taylor  
ECOM, Fort Monmouth, NJ 07703  
Technical rept. No. ECOM-2939, 19p (02/1968).  
Availability: AD-668 241  
NTIS

The results of an experiment designed as a quarter replicate of a 2 to the 7th power plan on factors affecting high-voltage breakdown in vacuum are given. The significance of each of the seven factors is analyzed, showing the effect of electrode materials, electrode geometry, electrode finishes, and the bakeout process. A good degree of confidence was obtained showing that the anode material and anode geometry are important in the cause for breakdown. The results of these statistically designed experiments and other experiments performed investigating the activity in high-voltage gaps lead to the conclusion that anode effects play a major role in the breakdown process. Upon completion of the full line of designed experiments, the information gained from this work will be compiled in charts and graphs as a design monograph for the high-voltage high vacuum component design engineer. (Author)

Primary Keywords: Failure(Electronics); Vacuum; Voltage; Statistical Analysis; Radar Equipment; Design; Ion Accelerators; Space Propulsion; Particle Accelerators; Test Methods; Electrodes; Geometry; Materials; Anodes; Cathodes

Secondary Keywords: Graphs(Charts)

5658  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
EFFECT OF ATMOSPHERIC HUMIDITY ON BREAKDOWN VOLTAGE OF VARIOUS SPARKOVER LENGTHS AT VARIOUS VOLTAGE FORMS  
M.S. Guindehl  
Eidgenossische Technische Hochschule, Zurich, Switzerland  
Einfluss Der Luftfeuchtigkeit Auf Die Durchbruchspannung Verschiedener Funkenstrecken Bei Verschiedenen Spannungsformen No. D155-4347, 140p (02/1968).  
Availability: N70-38345  
NTIS

Primary Keywords: Atmospheric Moisture; Electrical Faults; Spark Gaps; Electric Potential; Flashover

5659  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES)  
(Vacuum, Electrical; Electrodes)  
ELECTRICAL BREAKDOWN BETWEEN ERBIUM OXIDE, ERBIUM DEUTERIDE, AND MOLYBDENUM ELECTRODES IN A VACUUM  
M.H. Davies, M.D. Owen and M.D. Powell  
Atomic Weapons Research Establishment, Aldermaston, Berkshire, UK  
No. AWRE-0-1/69, 32p (02/1969).  
Availability: N69-34178  
NTIS

Primary Keywords: Electrical Faults; Electrodes; Erbium Compounds; Molybdenum; Vacuum; Deuterides; Oxides; Spark Gaps

5661  
(SWITCHES, CLOSING)  
(Vacuum Gaps, Electrical)  
FIRING CHARACTERISTICS OF MULTIPLE-ELECTRODE TRIGGERED VACUUM GAPS  
S.B.A.J. Schneider and J.E. Crendon  
ECOM, Fort Monmouth, NJ 07703  
Research and development technical rept. No. ECOM-3025, 15p (10/1968).  
Availability: AD-677 381  
NTIS

The design of a multiple-electrode triggered vacuum gap for 350-kilovolt operation as an energy diverter was described at the Ninth Modulator Symposium. This program was continued. In the design of the new tubes, the primary design objective was to achieve minimum firing times without sacrifice of voltage hold-off reliability. The arc length was considerably shortened and the ceramic sidewalls have been shielded from the arc. Three different designs were constructed. They are a six-gap tube, a three-gap tube, and a modified version of the three-gap tube with a hydrogen reservoir added. The firing characteristics of these tubes were studied from 1 kilovolt to 280 kilovolts. The influence of a low pressure of hydrogen on firing and hold-off was evaluated. (Author)

Primary Keywords: Discharge Tubes; Trigger Circuits; Electrodes; Design; Electric Arcs; Plasma Medium; Energy Management

5662  
(BREAKDOWN STUDIES)  
(Equipment)  
FURTHER DEVELOPMENT OF THE CASCADE HIGH POWER ARC CHAMBER  
M. Maecher and S. Steinberger  
Culham Translations Office, UK  
No. CTO-477, 12p (02/1968).  
Trans. From: Z. Angew. Phys. No. 8, pp 456-458 (1967)  
Availability: N68-38378  
NTIS

Primary Keywords: Arc Chambers; Plasma Cylinders; Copper; Electrical Insulation; Electrodes; Electromagnetic Fields; Heat Transfer; High Voltages; Silicon; Thermal Insulation

5663  
(PULSE GENERATORS)  
(Capacitor Banks)  
GENERATION OF RAPID RISE CURRENT PULSES IN THE MSEC RANGE FOR FAST COMPRESSION EXPERIMENTS  
G. Herppich and A. Knobloch  
Institut fur Plasmaphysik, Garching, FRG  
No. IPP-4/57, 48p (06/1968).  
Availability: N68-32280  
NTIS

Primary Keywords: Analysis (mathematics); Electric Energy Storage; Inductance; Pulse Generators; Shock Heating; Capacitors; Conferences; Costs; Electric Current; Electric Discharges; Magnetic Diffusion; Magnetohydrodynamic Generators; Plasma Generators

5666  
(SWITCHES, CLOSING)  
(Gas Gaps, Self)  
INHOMOGENEOUS AIR SPARK GAPS AT DIFFERING VOLTAGE LOAD  
K. Fesser  
Technische Hochschule Munchen (West Germany). Fakultat Fur Maschinenwesen Und Elektrotechnik  
Inhomogene Luftfunkenstrecken Bei Verschiedener Spannungsbeanspruchung (06/1968).  
Availability: N70-33687  
NTIS

Primary Keywords: Circuit Protection; Electric Potential; Overvoltage; Spark Gaps; Alternating Current; Direct Current; Electric Power Transmission; Surges; Volt-ampere Characteristics

5667  
(INSULATION, MATERIAL)  
(Solid)  
INSULATION STUDIES FOR HIGH POWER TUBES  
M.C. McGowan, E.J. Snook and D.L. Frey  
New Jersey Ceramic Research Station, New Brunswick, NJ  
Final rept. 27 Jan-26 Sep 69 (05/1970).  
Availability: AD-707 966  
NTIS

A feasibility study of insulation materials for application in high power electron tubes was made. Pertinent properties included: low dielectric constant (< 3.0), low dielectric loss (L0.0001), high thermal conductivity (0.5 cal/cm, sec. C). After an extensive literature search, a theoretical study was carried out on the fundamental factors affecting a material's property values. This was extended to include those materials, currently available, which most closely approximate the target values. The approaches to determine the feasibility of developing the desired new material centered around three areas: (1) observation of property value ranges for material classes, (2) analysis of property value trends for families of compounds based on the position of their elements in the Periodic Table, (3) a similar analysis based on the more promising crystal structures as predicted by radius ratios. No new material was found which better approximated the ideal than do BaO and BN. The trends in the data do not give much hope of finding a more ideal new compound. This study concludes that the most feasible approach to a closer approximation of the target values would be the growth and utilization of BN in whisker form. (Author)

Primary Keywords: Electron Tubes; Electric Insulation; Beryllium Oxides; Boron Compounds; Nitrides; Dielectric Properties; Thermal Conductivity; Feasibility Studies

Secondary Keywords: Boron Nitrides

5668  
(SWITCHES, CLOSING)  
(Miscellaneous Solid State)  
INVESTIGATION OF DESIGN OF HIGH VOLTAGE, HIGH CURRENT SOLID STATE SWITCHING DEVICES (FINAL TECHNICAL REPORT)  
E.R. Graf  
Auburn University, AL  
No. NASA-CR-98075, 109p (04/1968).  
Availability: N69-10271  
NTIS

Primary Keywords: Rectifiers; Semiconductor Devices; Switching Circuits; Semiconductor Junctions; Surges; Trigger Circuits

5669  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
INVESTIGATIONS ON LOW-INDUCTIVE SPARK GAPS FOR HIGH VOLTAGES IN AIR  
M. Pilschicker  
Technische Universitat, Brunswick (West Germany). Institut Fur Hochspannungstechnik.  
(10/1970).  
Availability: BMBW-FBK-70-17  
NTIS

For abstract, see NSA 25 04, number 07375.

Primary Keywords: Electric Fields

5670  
(PULSE GENERATORS)  
(Trigger)  
MODEL-10 PRECISION DELAY TRIGGER GENERATOR  
A.T. Brousseau  
Los Alamos National Labs, Los Alamos, NM 87545  
(08/1968).  
Availability: LA-3964-MS  
NTIS

Primary Keywords: Trigger Circuits; Delay Circuits; Plasma Physics

5671  
(SWITCHES, CLOSING)  
(Vacuum Gaps, Electrical)  
MULTIPLE-ELECTRODE TRIGGERED VACUUM GAPS  
S. Schneider, A.J. Buffa and J.E. Crendon  
ECOM, Fort Monmouth, NJ 07703  
IEEE Transactions On Electron Devices, Vol. ED-16, No. 3, pp 293-296 (03/1969).

Since the design criteria for reliable operation of a single gap at 300 kV are not well known, multiple-electrode triggered vacuum gaps were constructed. A six-gap structure was initially studied. It had excessive time delay in the initiation of the arc. Subsequently, a three-gap structure was built. Time delays in initiation of the arc were satisfactory, but the rate of rise of current was slow. In addition, voltage hold-off capability was marginal. To improve these characteristics, a low pressure of hydrogen, 7 to 25 mTorr, was added. Considerably improved firing characteristics and reliable voltage hold-off at 320 kV were obtained. 8 Refs.

Primary Keywords: 300 kV Operating Voltage; Six-gap Switch; Delay Measurement; Three-gap Switch Short Delay; Slow Current Rise; Gas Fill

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5672  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
PRESSURIZED SWITCHING UNIT DESIGNED TO START AND TO CROMBAR A  
TURBULENCE HEATING EXPERIMENT  
G. Klement and G. Mueller  
Institut fur Plasmaphysik, Garching, FRG  
No. IPP-4/52, 37p (06/1968).  
Availability: M68-32431  
NTIS

Primary Keywords: Spark Gaps; Switching Circuits; Trigger Circuits;  
Aluminum; Bibliographies; Electrodes; Epoxy Resins;  
Ferrites; Oscillographs; Pressure Chambers;  
Trigatrons

5676  
(ENERGY STORAGE, CAPACITIVE; SAFETY)  
(Capacitor Banks)  
SAFETY PROBLEMS IN THE JULIETTA CAPACITOR BANK  
F.J. Friedrich and A. Liedtke  
Institut fur Plasmaphysik, Garching, FRG  
No. JUL-540-PP, 18p (06/1968).  
Availability: M69-18694  
NTIS

Primary Keywords: Capacitors; Circuit Protection; High Current; Safety  
Devices; Capacitance Switches; Electric Energy  
Storage; Failure; Reactor Safety; Trigatrons

5677  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
SWITCHES FOR HIGH CURRENT DEVICES  
R. Wilhelm  
Institut fur Plasmaphysik, Garching, FRG  
Schalt Elemente Fuer Stossstromanlagen No. IPP-1/85, 33p (08/1968).  
Availability: M69-18790  
NTIS

Primary Keywords: Electric Switches; High Current; Plasma Physics;  
Spark Gaps; Electric Pulses; Ferrites; Foils  
(materials); Theta Pinch; Vacuum Apparatus

5678  
(POWER CONDITIONING)  
(Reviews)  
TECHNIQUES OF SHAPING HIGH-VOLTAGE NANOSECOND PULSES  
G.A. Vorobev and G.A. Mesyats  
FTD, Wright-Patterson AFB, OH  
No. FTD-MC-23-643-78, 168p (03/1971).  
Availability: AD-726 793  
NTIS

The monograph is the first attempt at a systematic presentation of  
material on the technique of shaping high-voltage nanosecond pulses.  
A considerable portion of the book is made up of the authors' works  
started at the high-voltage laboratory of Tomsk Polytechnic Institute  
in 1957 on the initiative of the Doctor of Physicomathematical  
Sciences Professor A. A. Vovob'yov. Description of devices for  
obtaining and converting the high-voltage nanosecond pulses is  
preceded by an analysis of the basic processes taking place in a  
spark with account taken of Weizel and Rompe theories and of the  
theory of streamer discharge and transient processes in a discharge  
circuit. (Author)

Primary Keywords: Pulse Generators; Configuration; Gas Discharges;  
Voltage; Measurement; USSR  
Secondary Keywords: Translations; Nanosecond Pulses

5679  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
THE DEVELOPMENT OF A LONG SPARK AND LIGHTNING  
I.S. Stekolnikov and A.V. Shkilev  
FTD, Wright-Patterson AFB, OH  
No. FTD-MT-24-46-68, 29p (03/1968).  
Trans. From: Energeticheskii Institut, Moscow Trudy, pp 97-100 (1966)  
Availability: AD-675 456  
NTIS

To increase the understanding of the growth process of long  
sparks, laboratory studies were conducted. In these image-converter  
tube graphs were constructed using an electron-converter tube with  
light amplification. To record the discharge current and voltage in  
the gap, a high speed electronic oscillograph was used. High optical  
sensitivity permitted a sharp focusing of the weak light fluxes of  
the initial spark stages. These spark studies were conducted with  
three different gap arrangements. (Author)

Primary Keywords: Electric Discharges; Production; Growth; Sparks;  
Lightning; Amplifiers; Light; Electron Tubes;  
Photographic Equipment; Image Converters; Electric  
Currents; Voltage; Oscillographs; Optical Scanning;  
Test Facilities; USSR  
Secondary Keywords: Translations; Coronas; Spark Gaps

5688  
(BREAKDOWN STUDIES)  
(Liquid, Electrical)  
THE IMPULSE BREAKDOWN IN INSULATING OIL  
M.G. Kratzenstein  
Technische Hochschule Munchen (West Germany). Fakultat Fur  
Maschinenwesen Und Elektrotechnik.  
Der Stossdurchschlag in Isolieroel (03/1968).  
Availability: M69-40758  
NTIS

Primary Keywords: Electric Discharges; Electrical Faults; Electrical  
Insulation; High Voltages; Mineral Oils; Electric  
Field Strength; Electrodes; Voltage Generators

5683  
(ENERGY STORAGE, MECHANICAL)  
(Rotating Machines)  
USE OF THE HOMOPOLAR GENERATOR TO POWER XENON DISCHARGE TUBES AND SOME  
ASSOCIATED SWITCHING PROBLEMS  
E.K. Inall  
Australian National University, Canberra, Australia  
No. EP-RR-23, 30p (03/1969).  
Availability: NT1-11368  
NTIS

Primary Keywords: Electric Equipment; Electric Generators; Electrical  
Faults; Electric Switches; Equipment Specifications;  
Failure Analysis; High Voltages

5684  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
A HIGH-POWER ELECTRIC SPARK IN AIR AT ATMOSPHERIC PRESSURE  
I.S. Abramson and I.S. Masys  
American Meteorological Society, Boston, MA  
No. T-R-414, 2p (12/1963).  
Availability: AD-602 128  
NTIS

Investigation of a spark, energized by a voltage source capable of  
supplying currents of several hundred amperes for a period of the  
order of 10 to the minus 8th power sec, showed that the voltage drop  
on the spark for such currents is considerably greater than the  
potential difference in a normal arc. By the end of the voltage dip,  
the diameter of the channel, determined by the Kerr cell, is  
independent of the current, at least in first approximation. There  
is a certain critical current density in the spark channel for the  
given potential difference between the electrodes. The quantity of  
energy liberated in the spark gap can be very large, owing to  
saturation. A discharge in metal-wire vapor is akin to a discharge  
with high current density in the last stage of the spark. (Author)  
Primary Keywords: ELECTRICAL DISCHARGES; ENERGY; SPARKS; ELECTRICAL  
PROPERTIES; ELECTRIC ARCS; VOLTAGE; ELECTRIC  
CURRENTS; ELECTRODES; GAS IONIZATION; PLASMA  
PHYSICS; USSR

5685  
(PULSE GENERATORS; POWER CONDITIONING)  
(Trigger; Saturable Reactors)  
A MAGNETO-DYNAMIC TRIGGER  
B.V. Bolotov and V.F. Kaluzhnyi  
FTD, Wright-Patterson AFB, OH  
(08/1964).  
Availability: AD-605 463  
NTIS

A new trigger is proposed containing a magnetic core with three  
magnetic contours of a material having hysteresis loops in a nearly  
rectangular position, and characterized by the fact that for the  
purpose of expanding the limits of the signal switch connection with  
power output, a 'Kholle' pick-up is placed in the first magnetic  
contour and, in the magnetic circuit of the other two, are placed  
toroidal cores on which is wound a commutating winding. (Author)  
Primary Keywords: MAGNETIC CORES; TRIGGER CIRCUITS; TRIGGER  
CIRCUITS; MAGNETIC CORES; SWITCHING CIRCUITS;  
MAGNETIC COILS; DESIGN; HYSTERESIS; PATENTS; USSR

5686  
(PULSE GENERATORS)  
(Trigger)  
A 15 KV TRIGGER-GENERATOR WITH SPARK GAP  
R.C. Kunze and E.V. Mark  
Institut fur Plasmaphysik, Garching, FRG  
15 Kv Triggergenerator Mit Funkenstrecke No. IPP-4/43, 13p (06/1967).  
Availability: M67-34499  
NTIS

Primary Keywords: Kerr Cell; Pulsed Generator; Spark Gap; Cell;  
Discharge; Fast; Gap; Generator; High Voltage;  
Jitter; Lifespan; Low; Power; Pulse; Rise; Sparks;  
Transient; Trigger  
Secondary Keywords: IN GERMAN; English Summary

5689  
(PULSE GENERATORS)  
(Trigger)  
DEVICE FOR TRIGGERING DISCHARGE TUBES IN A HIGH-VOLTAGE PULSE GENERATOR  
Y.F. Uslov  
FTD, Wright-Patterson AFB, OH  
No. FTD-MT-66-723, 7p (02/1967).  
Trans. From: Russian Patent No. 175 085  
Availability: AD-655 036  
NTIS

The patent describes a device for triggering discharge tubes in a  
high-voltage pulse generator containing a generator of triggering  
pulses, electrodes of an ignition discharge tube, and a section of  
coaxial cable. For the purpose of preventing the shunting of the  
resistance of the load of the generator by the ignition circuit and  
the protection of the generator of the triggering generator from the  
action of high tension, a section of the coaxial cable over which the  
triggering pulse is passed to the ignition discharge tube is wound on  
a core of ferromagnetic material, and the sheath of the cable is  
grounded from the side of generator of the triggering pulses.

Primary Keywords: Pulse Generators; Trigger Circuits; Trigger  
Circuits; Discharge Tubes; Electrodes; Coaxial  
Cables; USSR; Patents

5695  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES; INSULATION, MATERIAL;  
INSULATION, VACUUM)

(Vacuum, Electrical; Liquid, Electrical; Liquid)  
HIGH-VOLTAGE BREAKDOWN IN VACUUM AND IN OIL

L.M. Bettenhausen  
Battelle Memorial Institute, Columbus, OH  
BRI Report No. BMI-197-12-1 (10/1962).  
Availability: AD-294022

NTIS  
A summary is given of the state of knowledge and current research into high-voltage breakdown in vacuum and in oil. It is directed toward engineers who will use vacuum and oil as electrical-insulation media. The nature of the breakdown phenomena in vacuum is discussed. Current research into vacuum breakdown is then considered. A description of the breakdown phenomena in liquid dielectrics is the next topic, with emphasis on the behavior of insulating oils. The amount of source literature available on the topic of liquid dielectrics is staggering. Three reviews of this subject have been published within the past year alone; the reader will be referred to these for a more detailed treatment. While recent reviews of vacuum-breakdown phenomena have appeared, considerable new information has become available and is included herein for additional assessment. 169 Refs.

Primary Keywords: Vacuum Breakdown; Qualitative Overview; Electrode Effects; Modeling; Surface Flashover; Oil Breakdown; Modeling

5697  
INDUCTANCE EFFECTS IN ENERGY DIVERTER DISCHARGE CIRCUITS

G.W. Taylor and S. Schneider  
ECOM, Fort Monmouth, NJ 07703  
No. ECOM-2529, 2p (11/1964).  
Availability: AD-611 276

The effectiveness of energy-diverter protection can be reduced by the presence of inductance between the energy diverter and the 'protected system'. Two primary effects caused by inductance have been noted. The first effect occurs when the fault-sensing circuit triggers the energy-diverter during a high-impedance fault. In this case a large voltage oscillation about the zero reference level appears at the 'protected system'. If the inductance is large, the oscillation will be maintained for a long period and will prevent quick removal of voltage. The second effect occurs when the fault-sensing circuit triggers the energy diverter during a low-impedance arc. In this case the large inductance retards arc quenching. As the arc attempts to quench, the voltage oscillation reappears because of the energy stored in the inductor, and arc quenching is prevented. Observations on a system and an analysis of the circuit are discussed. (Author)

Primary Keywords: ELECTRONIC SWITCHES; ELECTRIC DISCHARGES; SWITCHING CIRCUITS; ELECTRONIC SWITCHES; INDUCTANCE; TRIGGER CIRCUITS; VOLTAGE; OSCILLATION; ELECTRONICS; ELECTRICAL IMPEDANCE; ENERGY; DELAY CIRCUITS

5698  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES)  
(Vacuum, Electrical; Electrodes)

INFLUENCE OF ELECTRODE MATERIAL ON HIGH-VOLTAGE VACUUM BREAKDOWN

M.H. Zinn, G.W. Taylor and M.H. Chresta  
ECOM, Fort Monmouth, NJ 07703  
Research and Development Technical rept. No. ECOM-2901, 16p (01/1968).  
Availability: AD-664 145

NTIS  
The question of which electrode in a two-electrode system, the anode or the cathode, contributes most to the primary voltage breakdown mechanism, and the reasons for this contribution have been the subject of wide debate among workers in the field. Theories of breakdown that involve the anode or the cathode or both to varying extent have been proposed by Crenberg, Albert, et al., Slivkov, Utsumi and Delmon, and others. Recent data collected by Watson, Mulcahy, and Bell and by Kranjec and Ruby, when subjected to analysis, indicate a role of the anode material in the breakdown process sufficiently clear to be applied in high-voltage vacuum tube construction. Both the analysis and data collected by Taylor and Chresta indicate that heating of the anode owing to the flow of field emission is a primary cause of breakdown at spacings of interest in vacuum tube technology. (Author)

Primary Keywords: Electric Discharges; Vacuum; Electrodes; Materials; Voltage; Theory; Regression Analysis; Field Emission

Secondary Keywords: Breakdown(Electrical)

5699  
(ELECTROMAGNETIC LAUNCHERS)  
(Railguns)

INVESTIGATION OF AN ARC GUN  
T. Fujii, E.P. Palmer and R.W. Grow  
University of Utah, Salt Lake City, UT  
No. uu-6, 2p (08/1960).  
Availability: AD-604 499

NTIS  
To satisfy needs for a superior hypervelocity gun, a study was made of the possibility of converting the electrical energy in a capacitor bank to kinetic energy of a projectile through the use of an electric arc discharge in a gun chamber. An arc gun was developed consisting of a chamber with a pair of electrodes and an accelerating barrel. To operate the gun, the chamber is packed with lithium hydride and the barrel is fitted with a nylon pellet. The capacitor bank is discharged into the chamber, causing conversion of the lithium hydride into a low-molecular gas. The expansion of the light gas accelerates the pellet. With a 30 microfarad capacitor bank charged to 17 kilovolts, a 3.7 milligram nylon projectile was accelerated to 5.0 kilometers per second. The efficiency of the energy conversion from the capacitor to the arc was 58.2 per cent, and the efficiency of the energy conversion from the arc to the projectile was 1.82 per cent. The total efficiency of the energy conversion from the capacitor to the projectile was 1.1 per cent. (Author)

Primary Keywords: ELECTRIC GUNS; LIGHT GAS GUNS; HYPERVELOCITY GUNS; LIGHT GAS GUNS; LIGHT GAS GUNS; ELECTRIC ARCS; FIRING MECHANISMS (WEAPON); GUN COMPONENTS; LITHIUM COMPOUNDS; HYDRIDES; NYLON; PELLETS; PROJECTILES; PROPELLANTS; TRIGGER CIRCUITS; ENERGY CONVERSION

Secondary Keywords: ARC GUNS

5701  
(BREAKDOWN STUDIES)

(Gas, Electrical)  
METHODS FOR DETERMINATION OF TRANSPORT COEFFICIENTS FROM HIGH POWER ARCS

H. Mecker  
Technische Hochschule Munich (West Germany) Elektrophysikalisches Institut  
Final scientific rept. 1 Oct 62-31 Jan 67 (10/1967).  
Availability: AD-661 995

NTIS  
Analytical methods and instruments were developed to aid in the study of transport coefficients in nitrogen, hydrogen, and argon arcs at temperatures above 15,000K. The transport properties considered were electrical conductivity, heat flux potential, thermal conductivity, and specific radiation.  
Primary Keywords: Electric Arcs; Transport Properties; Plasma Medium; Transport Properties; Gas Discharges; Transport Properties; Gas Ionization; Laboratory Equipment; Argon; Line Spectrum; Intensity; Hydrogen; Nitrogen; Electrical Conductance; Thermal Conductivity

5703  
(BREAKDOWN STUDIES)

(Gas, Optical)  
GAS BREAKDOWN BY SINGLE 20PS, 1.06UM AND 0.53UM LASER PULSES

C.L.M. Ireland and C.G. Morgan  
University College of Swansea, Singleton Park, Swansea, Wales  
Journal Of Physics D: Applied Physics, Vol 7, No. 8, pp 187-L90 (05/1974).

The pressure dependence of the intensity for optical frequency breakdown of nitrogen and argon has been studied using single 20 ps, Nd:sup 3+ laser pulses at the fundamental and second harmonic frequencies. The gases were studied over a pressure range of 10^-6-10e5 Torr at 1.06 um and 10e4-10e5 Torr at 0.53 um. The results lend support to the view that breakdown at both frequencies proceeds via cascade collisional ionization rather than by multiphoton ionization. 15 Refs.

Primary Keywords: Pressure Dependence; Nitrogen And Argon; Cascade Collisional Breakdown; Multiphoton Ionization

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5706  
(INSULATION, MATERIAL)  
(Solid)

SILICONE RUBBER GRADED CONSTRUCTION FOR HIGH VOLTAGE INSULATION

S.J. Mizinski  
Dow Corning Corp, Midland, MI  
(01/1961)  
Availability: AD-656 174

NTIS  
The results obtained show that the electric strength of silicone rubber insulated cable can be increased by using a graded construction, when one layer has a high dielectric constant and the other a low dielectric constant. Silicone rubber is easily adapted to this method because the dielectric constant can be varied from 3 to 7.5 by varying the amount of titanium dioxide added to the silicone rubber base. By making use of silicone rubber's versatility the breakdown voltage was increased by 50%. The amount of increase in breakdown voltage obtained depends upon the variables mentioned in the discussion of the calculated breakdown voltages. The capacitance also increases along with the breakdown voltage. This variation may or may not be important depending upon the application. Two possible applications of graded constructions are ignition cable and gas-turbine sign cable. (Author)

Primary Keywords: Electric Insulation; Silicone Plastics; Voltage; Dielectric Properties; Electric Cables; Manufacturing Methods

5709  
(BREAKDOWN STUDIES)  
(Exploding Wires)

INSTABILITIES OF ELECTRICALLY EXPLODED WIRES

A.E. Vlastos  
The Royal Institute of Technology, Sweden  
Journal Of Applied Physics, Vol. 44, No. 4, pp 1616-1621 (04/1973).  
The experimental results summarized in this paper, which have been obtained with thin tungsten, copper, and constantan wires, give further evidence that electromagnetic macroinstabilities may develop near the melting point of thin wires which are heated by the sudden release of electrical energy and lead to their disintegration. At low-energy-input rates, screw-type instabilities develop in all the wire materials used. On the other hand, at high-energy-input rates, the copper and constantan wires show striations after the explosion, while tungsten wires are not striated but are split into tiny fibers which emerge along the whole wire. At the beginning the restrike channel of copper and constantan wires has an helicoidal form. Annealed wires show the same results. Helical channels were not observed in tungsten wires. By twisting the copper and constantan wires in the opposite direction to the channel helix, it was possible to change the direction of the helix. Thus, the helical shape of the channel may be an effect produced by the twisting of the wire in mounting it between the electrodes. The possibility that the helicoidal shape of the channel is due to some other effect is also discussed. 17 Refs.

Primary Keywords: Exploding Wire; Tungsten Wire; Copper Wire; Constantan Wire; Macroinstability; Screw-type Instability

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5710  
(INSULATION, MATERIAL)  
(Solid)

THE INTERRELATIONSHIP BETWEEN DENSITY AND DIELECTRIC STRENGTH OF HIGH PRESSURE POLYETHYLENE FOR HIGH VOLTAGE APPLICATIONS IN INSULATED WIRES

A.S. Silver  
Royal Electric Corp, Pawtucket, RI  
(12/1957)  
Availability: AD-656 418

NTIS  
Data is presented which shows that branched P. E. manufactured by the high pressure system must be insulated properly in order to maintain a high density and crystallinity to give maximum dielectric strength in cable. (Author)  
Primary Keywords: Polyethylene Plastics; Electric Insulation; Electric Wire; Density; Dielectric Properties; Crystallization; Data; Electric Cables

- 5711  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Impedance)  
THE MEASUREMENT OF IMPEDANCE AT HIGH POWER  
R.E. Ford and C.W. Stoops  
Naval Research Lab. Orlando, FL  
(10/1967)  
Availability: AD-661 230  
NTIS  
A method and the electronic equipment for applying it was developed to enable the impedance of a transducer or other device, linear or nonlinear, to be calculated from measurements made while the device is operating at high power, pulsed or c-w. The method involves the use of a null-balance technique by which the current and voltage of a c-w reference signal are compared with samples of the 'unknown' signal and nulled against the unknown on an oscilloscope. The relative phase also is measured. Toroidal transformers provide the means of extracting samples from the high driving voltage and current. The electronic components are of solid-state circuitry throughout. (Author)  
Primary Keywords: Electrical Impedance Measurement; Transducers; Test Methods; Power; Underwater Sound Equipment; Calibration; Phase Measurement; Electric Currents; Voltage; Test Equipment (Electronics)
- 5714  
(SWITCHES, CLOSING)  
(Thyristors)  
THE SCR AS A HIGH POWER MODULATOR SWITCH  
A.S. Cardello  
RADC, Griffiss AFB, NY 13440  
RADC Report No. RADC TR 67-625 (12/1967)  
Availability: D 644331  
NTIS  
This report is a survey of the current state-of-the-art in the use of silicon controlled rectifiers in high power modulator switch series. A brief description of the device and device characteristics is included. The report describes several contractual efforts which proved the feasibility of applying the devices to high power equipments and in detail describes the device development of circuitry, triggering techniques and device improvements. The applications discussed in the report show that the silicon controlled rectifier has been used in a 5 megawatt modulator and is capable of operation at power levels of 25 megawatts and beyond. Continued efforts in this area will prove the high power capability of the device in practical applications. 8 Refs.  
Primary Keywords: Silicon Controlled Rectifier; Modulator; Characterization; Performance Test; Triggering Considerations
- 5715  
(PARTICLE BEAM, ION)  
(Generation)  
ION ACCELERATION IN A MAGNETICALLY INSULATED DIODE  
Y.I. Bakshaev, P.I. Blinov, G.I. Dolgavchev and V.A. Skoryupin  
I.V. Kurchatov Institute of Atomic Energy, Moscow, USSR  
Soviet Journal Of Plasma Physics, Vol. 5, No. 5, pp 583-584 (09/1979).  
Trans. From: Fiziki Plazmy, Vol. 5, pp 1041-1043  
Experiments have been carried out to determine the mechanism for the formation of the anode plasma and to study the ion acceleration in a magnetically insulated coaxial diode. The anode plasma forms as a result of electron bombardment of the polyethylene anode. In a magnetic field  $H(3-8) \text{ kG}$  sub c/r, the ion current density reaches  $60 \text{ A/cm}^2$  sup Zr, while the insulation lasts 1 usec. 4 Refs.  
Primary Keywords: Magnetic Insulation; Anode Plasma; Electron Bombardment; Electric Discharge  
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- 5733  
HIGH-VOLTAGE PULSE MONITOR SYSTEM FOR NEUTRINO ELECTRON ELASTIC SCATTERING  
C. Dalton  
Los Alamos National Labs, Los Alamos, NM 87545  
(08/1980)  
Availability: LA-8505-MS  
NTIS  
The Neutrino Electron Elastic Scattering Experiment will use 40 high-voltage pulsers and 40 flash-chamber detector modules. This report describes the proposed microprocessor controlled monitor system to safely and efficiently operate the high-voltage pulsers and flash chambers. (ERA citation 05:037095)  
Primary Keywords: Data Acquisition Systems; High-voltage Pulse Generators; Target Chambers; Lamp Lines; Microprocessors; Neutrino-electron Interactions; On-line Control Systems  
Secondary Keywords: ERDA/430303; NTIS02
- 5782  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
PARTICLE-INITIATED BREAKDOWN IN GAS DIELECTRIC CABLE INSULATION EXPANDED SCOPE PROGRAM (FINAL REPORT)  
C.M. Cooke  
Massachusetts Institute of Technology, Cambridge, MA  
(11/1979)  
Availability: EPRI-EL-1264  
NTIS  
The adverse influence of conducting particle contaminants in gas-insulated power apparatus was investigated in a series of experiments that employed coaxial configurations and dc voltages to 1500 kV. Particle dynamics was shown to be important and related to breakdown initiation in the gas. Both SF sub 6 and N sub 2 gases at pressures from 1 to 14.6 atm absolute were used. The particles were intentionally introduced and ranged from 1.6 to 6.4 mm spheres and wires. Effects in the gas gap as well as along surfaces of solid insulators were studied. Visual observations, photographs, and electrical measurements helped in distinguishing various processes. Particles could reduce the insulation performance by factors of 3 to 5 and were especially significant when moved to the center conductor. By coordination of this work with a separate study at the Westinghouse R and D laboratory, a comparison between dc and ac performance was made. Generally the dc breakdown values exhibited wider scatter, though their lower limit was similar to that found under ac. Overall fundamental forces and processes which involve particle contamination effects were identified and found to be the same for dc and ac voltage stresses. (ERA citation 05:015703)  
Primary Keywords: Gas-insulated Cables; UHV Dc Systems; Aluminum; Breakdown; Coaxial Cables; Comparative Evaluations; Dielectric Materials; Electrical Insulation; Experimental Data; Graphs; Nitrogen; Particles; Power Transmission Lines; Pressure Dependence  
Secondary Keywords: ERDA/280302; NTIS02
- 5798  
(PULSE GENERATORS)  
(Marx)  
A SOLID STATE NANOSECOND PULSER USING MARX BANK TECHNIQUES  
E.A. Jung and R.N. Lewis  
Argonne National Lab, Argonne, IL  
Nuclear Instruments And Methods, Vol. 44, No. 2, pp 224-228 (10/1966).  
This pulser generates a 5 kV pulse into 50 ohm, 17 nsec after receiving a .33 V input signal. The voltage is derived from capacitors which are charged in parallel and discharged in series. Avalanche transistors are used as the switching elements from the 1 to 1 kV level, while Elkonite spark gaps are used from the 1 to 5 kV level. Pulse repetition rates in excess of 100 pps at readily obtainable and output pulse jitter is less than 1 nsec. 4 Refs.  
Primary Keywords: Solid State Pulser; Marx Generator; Avalanche Transistor; 5 kV Output Voltage; Rep-rated  
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- 5801  
(ENERGY CONVERSION, ELECTRICAL; PULSE GENERATORS)  
(Charging Circuits; Marx)  
CHARGING TIME OF A HIGH-VOLTAGE IMPULSE GENERATOR  
G.W. Swift  
University of Manitoba, Winnipeg, Manitoba, Canada  
Electronics Letters, Vol. 5, No. 21, pp 534 (10/1969).  
The charging characteristics of Marx generators are considered. A time constant is defined by taking the product of the total parallel capacitance and total series resistance. This time constant will give the time required to charge a bank of several sections to 93% of its final value. 0 Refs.  
Primary Keywords: Marx Generator Charging; Waveform Prediction; Time Constant Definition; Theoretical Justification  
COPYRIGHT: 1969 INSTITUTION OF ELECTRICAL ENGINEERS
- 5802  
(ENERGY STORAGE, MECHANICAL)  
(Rotating Machines)  
ENERGY STORAGE AND TRANSFER WITH HOMOPOLAR MACHINE FOR A LINEAR THETA-PINCH HYBRID REACTOR  
M.F. Vogel (1), M. Brennan (2), W.G. Dase (2), K.M. Tolc (2) and M.F. Weldon (2)  
(1) Los Alamos National Labs, Los Alamos, NM 87545  
(2) University of Texas at Austin, Austin, TX 78712  
Los Alamos Report No. LA-6174 (12/1975).  
Availability: LA-6174  
NTIS  
This report describes the energy storage and transfer system for the compression coil system of a linear theta-pinch hybrid reactor (LTPHR). High efficiency and low cost are the principal requirements for the energy storage and transfer of 25 MJ/m or 25 GJ for a 1-km LTPHR. The circuit efficiency must be approximately 90%, and the cost for the circuit 5-6 cents/J. Scaling laws and simple relationships between circuit efficiency and cost per unit energy as a function of the half cycle time are presented. An important consideration concerns the pulse repetition rate of 2-25 pulses per second, 70E6 shots/yr, or 1.7E9 shots over the 25-yr plant life. Current interruption to initiate energy transfer is not feasible at this rate. We consider, therefore, a simple ringing circuit with zero-current instances. Even this simple operation will require considerable development effort for an inexpensive and reliable reactor that may be replaced during annual plant maintenance. We consider capacitors and homopolar machines as energy storage elements with both functioning basically as capacitors. The advantage of the homopolar machine in this application is its relatively low cost, whereas that of capacitors is better efficiency. 12 Refs.  
Primary Keywords: Homopolar Generator; Energy Transfer; High Efficiency; Rep-rated; High Reliability
- 5826  
INVESTIGATION OF THE EROSION PHENOMENON IN HIGH CURRENT, HIGH PRESSURE GAS DISCHARGES  
J.E. Gruber and R. Suess  
Institut fur Plasmaphysik, Garching, FRG  
(12/1969).  
Availability: IPP-4/72  
NTIS  
For abstract, see NSA 25 04, number 07379.  
Primary Keywords: Plasma Medium; Gas Discharges
- 5827  
(PULSE GENERATORS; ENERGY STORAGE, CAPACITIVE)  
(Marx; Marx Generators)  
MARX--AND MARX-LIKE--HIGH-VOLTAGE GENERATORS  
R.A. Fitch  
Mallory Labs Inc, San Diego, CA 92123  
IEEE Transactions On Nuclear Science, Vol. NS-18, No. 4, pp 190-198 (04/1971).  
Major developments have taken place in the art of Marx generating in recent years. The rationale, modi operandi and relative merits of these developments are discussed in an attempt at exegesis and classification. 7 Refs.  
Primary Keywords: Marx Generator; Principles Of Operation; History; Design Considerations; Folded Marx; Back-coupled Marx  
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- 5839  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Gas, Optical; Gas Gaps, Optical)  
ELECTRICAL DISCHARGE THROUGH LASER-INDUCED SPARK  
V.I. Vlodimirov, G.M. Malyshev, G.T. Razdobudin and V.V. Semenov  
A.F. Joffe Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Leningrad  
Soviet Physics-Technical Physics, Vol. 12, No. 9, pp 1277-1279 (03/1968).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 37, 1742-1745 (September 1967).  
An electrical discharge occurs in a region produced by a laser-induced spark in air at potentials two-to-three orders of magnitude lower than the breakdown potential of air. The initiation of the breakdown is associated with the arrival of a region of reduced density at the electrode. For electrode potentials from 30 V to 3 kV the peak current ranges from 50 A to 11 kA and the resistance varies from 0.5-0.07 ohm. The duration of current flow is about 40 microseconds. 6 Refs.  
Primary Keywords: Reduced Density Region; Electrode Effects; Low Resistance; Blast Wave  
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5840  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Gas, Optical; Gas Gaps, Optical)  
INVESTIGATION OF AN ELECTRIC DISCHARGE ACROSS A LASER SPARK  
V. I. Vladimirov, G. M. Relyshev, G. T. Radzoberin and V. V. Semenov  
A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the  
Ukrainian SSR, Leningrad  
Soviet Physics-Technical Physics, Vol. 14, No. 5, pp 677-680 (11/1969).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 39, 906-910 (May 1969).  
Behind the front of the shock wave a laser spark produces a hot  
region which creates conditions for the initiation of an electric  
discharge. The shock-wave front separates from the boundaries of the  
hot region at a velocity of 3E5 cm/sec 100 nsec after the start of  
the laser spark. The onset of the discharge depends on the position  
of the electrodes relative to the center of the hot region. The  
developed discharge is self-sustaining. 4 Refs.  
Primary Keywords: Tungsten Electrode; Variable Focal Plane Position;  
Low Voltage; Gap Resistance Measurement  
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PERMISSION

5841  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Vacuum, Optical; Vacuum Gaps, Optical)  
LASER-INITIATED VACUUM DISCHARGE  
V. P. Kovalenko, A. A. Makarevich, V. A. Rodichkin and A. M. Timonin  
Soviet Physics Technical Physics, Vol. 19, No. 11, pp 1429-1431  
(05/1975).  
Trans. From: Zh. Tekh. Fiz. 44, 2317-2321 (November 1974).  
The amplitude and time characteristics of a vacuum discharge  
(initial pressure  $\approx 2 \times 10^{-6}$  Torr) are studied in a two-electrode gap.  
The discharge is driven by the light pulse from a 15 MW ruby laser,  
which is focused on one of the electrodes. As the laser-produced  
plasma expands across the gap, a current flows due to the emission of  
charged particles from the plasma and changes caused in the strength  
and configuration of the electric field in the gap by the laser  
plasma. The maximum current across the gap and the time required for  
this current to reach its maximum value are functions of the gap  
voltage ( $U_{\text{sub}} \approx 5-50$  kV) and the capacitance ( $C_{\text{sub}} \approx 1100-4400$   
pF). 3 Refs.  
Primary Keywords: Laser Initiated Breakdown; Variable Polarity; X-ray  
Beam; Intensity Dependence; Very Short Delay Time  
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5844  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
PHYSICS OF A SPARK VACUUM DISCHARGE AND QUANTITATIVE MASS-SPECTROMETRIC  
ANALYSIS. QUALITATIVE MODEL OF A WEAK CURRENT VACUUM DISCHARGE  
G. I. Ranendik and V. I. Derzhiev  
V. I. Vernadskii Institute of Geochemistry and Analytical Chemistry,  
Academy of Sciences of the USSR, Moscow, USSR, Moscow, USSR  
Journal Of Analytical Chemistry Of The USSR, Vol. 32, No. 8 pp  
1197-1203 (08/1977).  
Trans. From: Zhurnal Analiticheskoi Khimii 32, 1508-1515 (August 1977).  
The authors present evidence for a model of the physics of vacuum  
breakdown. Three distinct stages are proposed and defined:  
breakdown-initiation, spark, and arc. Each stage is described in  
detail with theories presented for the mechanism of each stage. The  
passage of electrode material into the vacuum gap is discussed, as is  
the effect of electrode vaporization on the speed of breakdown.  
Particle density in the plasma channel formed is investigated.  
Recovery processes are also briefly discussed. 37 Refs.  
Primary Keywords: Vacuum Breakdown; Three Stages;  
Breakdown-initiation; Spark; Arc; Plasma Formation;  
Recovery After Current  
Secondary Keywords: Ion-source Mass Spectrometry  
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5848  
(PARTICLE BEAMS, ION)  
(Generation)  
ACCELERATION OF CHARGED PARTICLES BY INTENSE ELECTRON BEAMS  
G. Yonas  
Sandia Labs, Albuquerque, NM 87115  
Particle Accelerators, Vol. 5, pp 81-91 (01/1973).  
Ion acceleration by electron beams propagating in a plasma or  
neutral gas has resulted in the generation of ion beams with energies  
much greater than the accelerating e-beams. The ion acceleration  
occurs as the e-beam pinches in all cases. The author experimentally  
and theoretically investigates collective acceleration in a plasma  
filled diode. Results are presented to indicate that accelerating  
fields of over 1 MV/cm are present in the diode. 35 Refs.  
Primary Keywords: Collective Acceleration; Plasma Filled Diode; 1  
MV/cm Accelerating Field; Experiment; Theory  
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5851  
(BREAKDOWN STUDIES)  
(Lightning)  
DETECTION OF LIGHTNING SUPERBOLTS  
B. M. Turman  
Patrick AFB, Florida 32925  
Journal Of Geophysical Research, Vol. 81, No. 18, pp 2566-2568  
(08/1977).  
Lightning superbolts are the subject of this paper. The authors  
briefly describe the criteria that qualify a superbolt and proceed to  
describe the statistics of lightning superbolts. The primary criteria  
used are optical radiance and duration. Satellite based sensors are  
utilized as detection devices. 12 Refs.  
Primary Keywords: Lightning Detection; Superbolt Detection; Superbolt  
Statistics; Optical Radiance  
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5854  
(BREAKDOWN STUDIES)  
(Surface Flashover)  
ELECTRICAL BREAKDOWN OVER INSULATORS IN HIGH VACUUM  
P. H. Gleichauf  
Westinghouse Research and Development Center, Pittsburgh PA  
Journal Of Applied Physics, Volume 22, No. 5, pp 535-541 (05/1951).  
In the investigated range of  $5 \times 10^{-5}$  to  $1 \times 10^{-7}$  mm Hg, the breakdown  
voltage over insulators in high vacuum is independent of pressure.  
Currents of  $1 \times 10^{-11}$  to  $1 \times 10^{-8}$  ampere were observed in the region below  
breakdown voltage by detecting x-ray quanta with a Geiger-Mueller  
counter. Pinhole camera x-ray pictures revealed that practically all  
radiations originate from an area on the anode a distance from the  
insulator, with a weaker radiation coming from a ring immediately  
adjacent to the insulator. Current-voltage relationships as usually  
observed in these experiments indicate a roughness factor and an  
emitting area on the cathode similar to previous findings in vacuum  
gaps. Oscilloscopic observations revealed that sometimes at breakdown  
over insulators the voltage on the test sample drops to 2.5 kV; in  
other cases it falls to less than 100 volts. The low voltage arc-like  
discharge extinguishes at a current of about one ampere for copper  
electrodes in contact with Pyrex glass. As in a vacuum gap, the  
breakdown voltage over an insulator is increased by successive  
breakdowns. Part of this "conditioning" is permanent. The  
non-permanent part is dependent on the state of the test sample prior  
to conditioning. 10 Refs.  
Primary Keywords: Surface Flashover; Pyrex Insulator; Copper  
Electrodes; High Vacuum; X-ray Diagnostic; Voltage  
Measurement; Cutoff Current; Conditioning Effects  
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5855  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
ELECTRON BEAM FOCUSING USING CURRENT-CARRYING PLASMAS IN HIGH-NU/GAPMA  
DIODES  
G. Yonas, K. R. Prestwich, J. M. Poukey and J. R. Freeman  
Sandia Labs, Albuquerque, NM 87115  
Physical Review Letters, Vol. 30, No. 5, pp 164-167 (01/1973).  
A technique has been demonstrated for concentrating electron beams  
to  $5 \times 10^{-4}$  cm. plasmas on the axis of diodes. A two-dimensional  
particle code has been used to illustrate the importance of both the  
 $E \times B$  motion in vacuum and the self-pinch of the beam within the  
plasma. 5 Refs.  
Primary Keywords: Electron Beam Focusing; Diode Axis; High Nu/gamma  
Diodes; Self-pinched Diode; Current-carrying  
Plasmas; Theory; 2nd Particle Code  
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5860  
(SWITCHES, CLOSING)  
(Liquid Gaps, Self)  
HIGH POWER DENSITY WATER DIELECTRIC SWITCHING  
D. L. Johnson, J. P. Vandevender and T. H. Martin  
Sandia Labs, Albuquerque, NM 87115  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 3, pp 204-209  
(07/1980).  
Pulse forming networks for high current particle beam fusion  
accelerators must produce fast rise time, low jitter, low prepulse,  
and high voltage power pulses. Conventional water dielectric  
switching can provide the required rise time and jitter, but has  
limitations on prepulse and output voltage. A high power density, low  
prepulse, pulse forming line (PFL) configuration with self-breakdown  
water dielectric switches is presented. The design parameters and the  
results of switching experiments are described. 7 Refs.  
Primary Keywords: Self-break Water Switch; Prepulse Suppression;  
Ground Plane; Pulse Forming Line  
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5865  
(BREAKDOWN STUDIES)  
(Lightning)  
LIGHTNING DETECTION FROM SPACE  
B. M. Turman  
U.S. Air Force Academy, CO 80840  
American Scientist, Vol. 67, No. 3, pp 321-329 (06/1979).  
The author presents data on satellite lightning detection in this  
paper. Reasons are presented for using optical sensors for detecting  
lightning from space. The energy distribution of lightning is  
discussed and the presence of superbolts is hypothesized and  
confirmed. The waveshapes of lightning are studied, as is the  
probability that the bolt will have a given total energy and charge  
transfer. The possibility of implementing a satellite based severe  
storm early warning system is discussed. 23 Refs.  
Primary Keywords: Lightning; Normal Bolt; Superbolt; Positive Giant;  
Optical Lightning Detection; Storm Monitoring  
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5867  
(INSULATION, MAGNETIC)  
( )  
MAGNETIC INHIBITION OF SURFACE FLASHOVER OF INSULATORS IN VACUUM  
K. D. Bergeron and D. H. McDaniel  
Sandia Labs, Albuquerque, NM 87115  
Applied Physics Letters, Vol. 19, No. 9, pp 534-536 (11/1976).  
The possibility of preventing high-voltage surface flashover of  
insulators in vacuum by means of a strong magnetic field  
perpendicular to the electric field and parallel to the insulator  
surface is investigated theoretically. A simple model predicts that  
with the right choice of insulating material one can design diodes  
and transmission lines so that the magnetic field from the line  
current inhibits the secondary electron-emission avalanche which is  
believed to play an important role in the flashover process. 13 Refs.  
Primary Keywords: Surface Flashover; Modeling; Diode; Transmission  
Line; Theory; Secondary-electron-emission Avalanche  
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5870  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Particle Beams)  
MEASUREMENTS OF HIGH-CURRENT RELATIVISTIC ELECTRON DIODE PLASMA PROPERTIES WITH HOLOGRAPHIC INTERFEROMETRY  
J.G. Kelly and L.P. Mix  
Sandia Labs, Albuquerque, NM 87115  
Journal Of Applied Physics, Vol. 46, No. 3, pp 1084-1090 (03/1975).  
Double-exposure interference holography has been used to measure the temporal and spatial dependence of plasma densities and velocities in relativistic electron beam diodes. In this paper some of the physics revealed by a detailed analysis of holograms from one such diode is presented. Abel inversion of holograms taken on the Reba accelerator (100 kA, 1.5 MV) incorporating a 0.6-cm-diam glass rod cathode show the axial and radial structure of the diode plasmas. Fringe-shift analysis has yielded densities of  $5 \times 10^{17}$  -  $5 \times 10^{19}$  electrons/cm<sup>3</sup>, and magnetohydrodynamic pressure balance implies a plasma temperature of about 0.3 keV. In addition, exposure variation of the fringe pattern and motion of plasmas between pictures taken at different times during the pulse have indicated plasma velocities vs spatial position that vary from 1E6 to 1E7 cm/sec. 12 Refs.  
Primary Keywords: E-beam Generation; Field Emission Diode; Diode Plasma; Holographic Interferometer; REBA Accelerator  
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5872  
(PARTICLE BEAMS, ION; PARTICLE BEAMS, NEUTRAL)  
(Generation; Generation)  
NEUTRON PRODUCTION AND COLLECTIVE ION ACCELERATION IN A HIGH-CURRENT DIODE  
L.P. Bradley and G.W. Kusma  
Sandia Labs, Albuquerque, NM 87115  
Physical Review Letters, Vol. 29, No. 21, pp 1441-1445 (11/1972).  
New measurements demonstrate that neutrons produced in a high-current pulsed diode with deuterium-bearing electrodes are of beam-target origin. During a brief portion of a 70-nsec, 2-MV, 50-kA pulse, positive ions from the anode and cathode plasmas were observed to be accelerated toward the anode rather than the cathode as dictated by the externally applied field. Energetic deuterons were observed, behind a small aperture in the anode, which were the source of neutrons produced with Li or C anodes. 12 Refs.  
Primary Keywords: Collective Acceleration; Neutron Production; High Beam Energy; High Beam Current; Positive Ion; Anode Plasma; Cathode Plasma; Lithium Anode; Carbon Anode  
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5881  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Gas, Electrical; Gas Gaps, Optical)  
PREIONIZATION CONTROL OF STREAMER PROPAGATION  
L.P. Bradley  
Sandia Labs, Albuquerque, NM 87115  
Journal Of Applied Physics, Vol. 43, No. 3, pp 886-890 (03/1972).  
Streamer velocity is experimentally shown to vary with preionization in M/sub 2/ and 5F/sub 6/7/. The velocity has been controlled over orders of magnitude by introducing pulsed preionization ahead of already propagated streamer. The preionization is produced by pulsed UV irradiation. The pulsed electric field is uniform in the gap. Avalanche-streamer conversion times were observed which agree well with prediction. 13 Refs.  
Primary Keywords: Streamer Velocity Control; Quasistatic Preionization; Pulsed Preionization; Wide Range Of Control  
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5882  
PRELIMINARY DESIGN OF A 100 MZ, 350 KV SHORT PULSE GENERATOR  
G.J. Rohwein and M.T. Buttram  
Sandia Labs, Albuquerque, NM 87115  
(06/1977)  
Availability: SAND-77-0174  
NTIS  
This report describes a 350 kV pulser designed to generate 100 ns square pulses with 300 joules total energy at a pulse repetition frequency of 100 per second. This design incorporates a transformer charged helical coaxial pulse forming line. The considerations leading to this design are presented together with results from prototype experiments. The pulser which is presently in the construction and testing phase is described in detail. The pulser will be used for electron beam acceleration. (ERA citation 02:055490)  
Primary Keywords: Electron Sources; Pulse Generators; Design; Electron Beams; Performance Testing; Power Supplies; Transformers  
Secondary Keywords: ERDA/700203; ERDA/700208; NTISE4DA

5893  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
Z/SUB E/ < 1 OHM PINCHED ELECTRON DIODES  
J.W. Poukey  
Sandia Labs, Albuquerque, NM 87115  
No. CONF-751108-2, 9p (06/1977).  
Availability: SAND-75-3747  
NTIS  
High current pinched electron flow in diodes is shown to be self-limiting, in the sense that for given diode voltage the electron current approaches a limiting value as R/d (cathode radius/gap) implies infinity. The consequence is that in order to achieve electron impedances Z/sub e/ of less than 1 ohm, one may have to inject high-atomic-weight plasma into the diode.  
Primary Keywords: Electron Sources; Design; Electron Beams; Pinch Effect; Plasma  
Secondary Keywords: NTISERDA

5894  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
CENTERING A HIGH-CURRENT ARC IN A COAXIAL ARC CHAMBER  
E.K. Inall  
Australian National University, Canberra, Australia  
J. Phys. D: Applied Physics Ser. 2, Vol. 1, pp 1586-1586 (07/1968).  
When an electric arc carrying 100 kA or more occurs a few mm off the axis of a coaxial chamber, it experiences a force of several kg/cm of arc length, driving it further off the axis. This can be overcome and the arc maintained on the axis by dividing one electrode and the outer conductor into sectors. With such an arrangement arcs of more than 100 kA have burnt on the axis for the duration of runs lasting 0.5 s. 1 Refs.  
Primary Keywords: Coaxial Arc; High-current; Segmented Electrodes; Long Duration Arc; Force Analysis  
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5895  
(BREAKDOWN STUDIES; SWITCHES, OPENING)  
(Exploding Wires; Explosive Fuses)  
CORRELATED ELECTRICAL AND OPTICAL MEASUREMENTS OF EXPLODING WIRES  
F.D. Bennett, H.S. Burden and D.D. Shae  
Army Ammunition Research and Development Command, Aberdeen Proving Ground, MD 21005  
The Physics Of Fluids, Vol. 5, No. 1, pp 102-113 (01/1962).  
Description is given of a high-resolution streak camera and of an experimental method whereby streak-camera records and electrical measurements of exploding wires may be accurately correlated in time. Composite data together with derived values of resistance, power, and energy are given for 4 and 5 mil Cu wires at several voltages. These data are compared with the experimental and theoretical results of other workers. The transfer of energy from electrical to fluid-mechanical form is discussed as are problems having to do with formation of the shock waves. 30 Refs.  
Primary Keywords: Current Measurement; Voltage Measurement; Streak Photograph; Back Lighting; Peripheral Arc  
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5896  
(SWITCHES, OPENING; DIAGNOSTICS AND INSTRUMENTATION)  
(Explosive Fuses)  
CURRENT MEASUREMENT AND TRANSIENT SKIN EFFECTS IN EXPLODING WIRE CIRCUITS  
F.D. Bennett and J.W. Marvin  
Army Ammunition Research and Development Command, Aberdeen Proving Ground, MD 21005  
The Review Of Scientific Instruments, Vol. 33, No. 11, pp 1218-1226 (11/1962).  
The transient response of the coaxial, current-measuring shunt commonly used in high current, high frequency applications (up to 1 MHz) is analyzed by Laplace transform methods. The exact solution is obtained as is an approximate solution which allows estimates to be made of the errors expected. The current shunt measuring a damped oscillation will always report an initial current slope of zero, and the maximum current slope is sensed shortly after switch-on. It is several percent low in typical cases. At the true current maximum, the shunt reading is a few tenths percent low and lags the impressed current by a small fraction of a cycle. A second problem concerning the transient resistance of an idealized plate condenser is analyzed using the asymptotic solution for current. A numerical calculation indicates no alteration of initial conditions on the damped oscillation to arise from this source so long as the characteristic damping time of the transient skin effect is small compared with the ringing time. 14 Refs.  
Primary Keywords: Current Measurement; Coaxial Current Shunt; Laplace Analysis; Error Estimate  
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5897  
(BREAKDOWN STUDIES; SWITCHES, OPENING)  
(Exploding Wires; Explosive Fuses)  
HIGH-ENERGY DENSITIES BEFORE DWELL IN ELECTRICALLY EXPLODED WIRES  
F.H. Webb Jr., H.M. Bingham and A.V. Tollestrup  
Electro-Optical Systems, Inc., Pasadena, CA  
The Physics Of Fluids, Vol. 3, No. 2, pp 318-319 (04/1960).  
High-energy densities above 10 eV/atom have been placed in electrically exploded wires before current dwell. Power input and electrical conduction above the critical point are inferred. Lochter-Holtgreven has discussed the possible occurrence of this type of overheating. Funfer et al. also have reported achieving temperatures above 50000 K in exploding wires. Our results confirm theirs under different conditions. Our experiments took place in much shorter time intervals (1E-8 sec) where the energy losses due to radiation and ohmic breakdown across the gap are negligible during the initial conduction phase. The voltage and current were measured simultaneously using a resistive shunt and voltage divider and two traveling wave oscilloscopes. A series of single-frame photographs were also taken. The overheating has been achieved in fine wires of good conducting materials in circuits where the initial current rise is extremely rapid, and the reactance is slightly larger than the circuit resistance initially. The essential feature is to establish a large current density in the wire before the resistance increases sufficiently to throttle further current flow. 4 Refs.  
Primary Keywords: Exploding Wire; Initial Stages; Energy Density Before Current Pause; Critical Point; Aluminum Wire  
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5898  
(SWITCHES, OPENING; BREAKDOWN STUDIES)  
(Explosive Fuses; Exploding Wires)  
INITIAL PHASE OF THE EXPLODING WIRE PHENOMENON  
C.P. Nash and C.W. Olsen  
University of California, Davis, CA  
The Physics Of Fluids, Vol. 7, No. 2, pp 289-293 (02/1964).  
As an approximation to the behavior of a circuit containing an exploding wire, the differential equation for the discharge of a condenser through a resistive load which increases linearly with time has been solved analytically. The calculations indicate that inductive effects govern the energy consumption in the first pulse for small-diameter wires, while thermodynamic effects are important for large-diameter wires. The importance of the heat of vaporization per unit volume, the resistivity, and the temperature coefficient of resistivity is stressed. Due to their similarities in these properties, it is predicted, and confirmed experimentally, that gold wires and aluminum wires should display nearly identical first-pulse characteristics. 13 Refs.  
Primary Keywords: Exploding Wire; Analytical Calculation; Time Varying Resistor; Inductive Effects; Thermodynamic Effects; Gold Wire; Aluminum Wire  
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5899  
(BREAKDOWN STUDIES; SWITCHES, OPENING)  
(Explosive Fuses; Explosive Wires)  
ON THE MECHANISM OF EXPLODING WIRES  
C.P. Nash (1) and W.G. McMillan (2)  
(1) University of California, Davis, CA  
(2) University of California, Los Angeles, CA 90024  
The Physics Of Fluids, Vol. 4, No. 7, pp 911-917 (07/1961).  
Experimental measurements are given for the energy input and shock wave arrival times for 10-cm Mo. 40 Cu wires exploded in air at an initial voltage of 9.25 kV. Two shocks in air are observed, one for each pulse before and after the dark phase. Pulse duration measurements are also reported for wire explosions in gaseous He, N<sub>2</sub> sub 27, O<sub>2</sub> sub 27, Ar and CO<sub>2</sub> sub 3/ at 1 atm. Semiquantitative theoretical explanations are proposed for the increase in wire resistance which terminates the first current surge, and for the elapsed time (pulse duration) before the vapor density of the expanding wire material declines sufficiently for reignition of the discharge. 17 Refs.  
Primary Keywords: Exploding Wire; Copper Wire; Shock Wave; Double Shock; Energy Input; Pulse Duration; Several Environments  
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5900  
(SWITCHES, OPENING; BREAKDOWN STUDIES)  
(Explosive Fuses; Exploding Wires)  
SHOCK-PRODUCING MECHANISMS FOR EXPLODING WIRES  
F.D. Bennett  
Army Armament Research and Development Command, Aberdeen Proving Ground, MD 21005  
The Physics Of Fluids, Vol. 5, No. 8, pp 891-898 (08/1962).  
Single-fringe interferograms are presented of 4-mil Cu wires exploded at 20 kV into argon at ambient pressures of 1/8, 1/16, and 1/32 atm. Features discernible include a compressive-head shock wave, arc plasma, a weak plasma wave and the expanding metal wire. On the basis of certain plausible assumptions it is seen that the arc plasma has a temperature of about 2.5 eV; but its leading edge, a region not in thermal equilibrium, has electron temperatures approximately 1E5 eV and is the boundary of an electron-driven shock wave. 11 Refs.  
Primary Keywords: Exploding Wire; Copper Wire; Compressive-head Shock Wave; Electron-driven Shock Wave; Plasma Wave  
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5901  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Power)  
A DEVICE FOR MEASURING PULSE POWER  
K.A. Yakovlev, D.K. Penkrushina and Yu.G. Besin  
Instruments And Experimental Techniques, No. 4 pp 711-713 (07/1961).  
Trans. From: Priroda 1 Tekhnika 4, 89-91 (July-August 1961).  
A design for a device to measure the instantaneous power of a pulse is presented. The device can handle currents of 50 to 2100 A at voltages up to 15 kV over a frequency range of 0.8 to 8 MHz. Pulses can have a repetition frequency to 1 kHz, and the pulse duration can be 50 microseconds to 10 ms. 6 Refs.  
Primary Keywords: Pulse Power Meter; True Power Reading; 1-15 kV Voltage Range; 50-2100 A Current Range; 0.8-8 MHz Frequency Range  
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5902  
(ELECTROMAGNETIC COMPATIBILITY)  
(Grounding And Shielding)  
R/D-1-FREQUENCY SHIELDING PROVIDED BY BOLTED SEAMS CONNECTING ARMORED-PLYWOOD PANELS  
H.A. Lasitter  
Naval Civil Engineering Lab, Port Hueneme, CA  
Naval Facilities Engineering Command Report No. R-535 (06/1967).  
Availability: AD 816496  
NTIS  
Rooms shielded against radio-frequency (RF) signals are essential to the Navy's research and development and operational use of equipment sensitive to RF interference. A series of shielding-effectiveness measurements of armor-plated plywood sections representative of those used in the construction of radio-frequency shielded rooms has been conducted. Five sections and four bolted seams were subjected to wet cycles of 70 Deg.F. 100% RH, and to dry cycles of 200 Deg.F. 10% RH. The percent moisture content, thickness variability, DC resistance, and surface currents at 12.8 kHz were observed during the wet-dry cycles. DC surface resistance of the seams increased monotonically throughout the test period. Standard deviation of the surface current measurements reached a peak at approximately 12 days. Another series of tests indicated that seams caulked with silver-loaded compounds had distribution of surface currents similar to those of solid armored sheets. 10 Refs.  
Primary Keywords: Paradox Cage; Armored Plywood; Shielding Effectiveness; Variation With Temperature; Variation With Humidity; Quality Of Electrical Bond

5914  
(PARTICLE BEAMS, ELECTRON)  
(Target Interactions)  
DEEP CRATERS PRODUCED BY SHOCK FOCUSING IN RELATIVISTIC ELECTRON-BEAM DIODES  
J.C. Kelly and M.M. Widner  
Sandia Labs, Albuquerque, NM 87115  
Journal Of Applied Physics, Vol. 46, No. 10, pp 4515-4518 (10/1975)  
Narrow craters have been produced in aluminum-rod targets mounted in the anode of the Herex electron-beam accelerator (150 kV, 50 kA, 40 ns). These craters (approximately 0.025 cm in diameter), which are characteristically deeper than their diameter and which extend into the electrode materials significantly beyond the classical range of the primary electrons in a relativistic electron-beam diode, were generated by a converging shock wave that melted and fractured the material in the region of shock focus. It is suggested that similar craters seen by other experimenters were also produced by the same mechanism. 13 Refs.  
Primary Keywords: E-beam Focusing; Converging Shock Wave; Deep Craters; Hydrodynamic Code Calculations; Shock Focusing; 105 J Total Beam Energy; 150 kV Electron Beam; Herex Electron-beam Accelerator  
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5921  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
ELECTRON BEAM GENERATION IN PLASMA-FILLED DIODES  
P.A. Miller, J.W. Poukey and T.P. Wright  
Sandia Labs, Albuquerque, NM 87115  
Physical Review Letters, Vol. 35, No. 14, pp 940-943 (10/1975).  
A study has been made of the response of low-density (approximately 1E13 cu.cm.) plasmas when subjected to the very high electric fields of relativistic electron-beam-accelerator diodes. An anomalous resistive behavior has not been seen. Instead, sheath formation at the cathode and electron-beam generation across the sheath has been found. This has important applications to the design of diodes for future electron-beam machines. 12 Refs.  
Primary Keywords: Low Density Plasma; Field Emission Diode; Cathode Sheath Formation; Electron-beam Generation; High Electric Fields; Anode Plasma  
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5928  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
HIGH POWER ELECTRON BEAM ACCELERATORS FOR GAS LASER EXCITATION  
J.G. Kelly, T.H. Martin and J.A. Halbleib  
Sandia Labs, Albuquerque, NM 87115  
(06/1976).  
Availability: SAND-75-5682  
NTIS  
A preliminary parameter investigation has been used to determine a possible design of a high-power, relativistic electron beam, transversely excited laser. Based on considerations of present and developing pulsed power technology, broad area diode physics and projected laser requirements, an exciter is proposed consisting of a Marx generator, pulse shaping transmission lines, radially converging ring diodes and a laser chamber. The accelerator should be able to deliver approximately 20 kJ of electron energy at 1 MeV to the 10 exp 4 cm exp 2 cylindrical surface of a laser chamber 1 m long and 0.3 m in diameter in 24 ns with very small azimuthal asymmetry and uniform radial deposition. (ERA citation 02:001364)  
Primary Keywords: Electrostatic Accelerators; Gas Lasers; Electron Beams; Electron Sources; Excitation; Kilo Amp Beam Currents; Mev Range 01-10; Planning  
Secondary Keywords: ERDA/430100; ERDA/420300; NTISERDA

5933  
(PARTICLE BEAMS)  
(Generation)  
ION SHEATH MOTION IN PLASMA-FILLED DIODES  
M.M. Widner and J.W. Poukey  
Sandia Labs, Albuquerque, NM 87115  
The Physics Of Fluids, Vol. 19, No. 11, pp 1838-1840 (11/1976).  
The time development of the ion space charge sheath in a plasma-filled planar diode is considered in reference to the behavior of relativistic diodes used for electron and/or ion beam production.  
Primary Keywords: E-beam Generation; Ion Beam Generation; Plasma Filled Diode; Planar Diode; Diode Closure  
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5954  
(BREAKDOWN STUDIES)  
(Exploding Foils)  
SELF-SIMILAR POWER-DRIVEN EXPANSION INTO VACUUM  
K.E. Lonngren  
University of Iowa, Iowa City, IA 52240  
The Physics Of Fluids, Vol. 22, No. 5, pp 859-865 (05/1979).  
Planar, power-driven expansion into a vacuum is found to be self-similar for a power-law driving source for the two ideal cases of a thick slab and a thin foil. For the thick slab expansion, an asymptotic solution for the far-blowoff region is obtained and a numerical solution is present for the rest of the expansion wave. For the thin foil expansion, an analytical solution is obtained. In both cases, the solutions exhibit an unbounded flow field with velocities tending to infinity as a consequence of the continuous assumption, a finite temperature limit for the far-blowoff material, and density profiles that decrease as a Gaussian in the far expanded material. 15 Refs.  
Primary Keywords: Exploding Foil; Expansion Into Vacuum; Thin Foil; Thick Slab; Power-law Driving Source; Self Similarity  
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5970  
(SWITCHES, CLOSING)  
(Liquid Gaps, Self)  
UNTRIGGERED WATER SWITCHING  
J.P. VanDevender and T.H. Martin  
Sandia Labs, Albuquerque, NM 87115  
IEEE Transactions On Nuclear Science, Vol. NS-22, No. 3, pp 979-982 (06/1975).  
Recent experiments indicate that synchronous untriggered multichannel switching in water will permit the development of relatively simple, ultra-low impedance, short pulse, relativistic electron (REB) accelerators. These experiments resulted in the delivery of a 1.5 MV, 0.75 MA, 15 ns pulse into a 2 ohm line with a current risetime of 2514 A/sec. The apparatus consisted of a 3 MV Marx generator and a series of three 112 cm wide strip water lines separated by 2 edge-plane water-gap switches. The Marx generator charged the first line in <400 ns. The first switch then formed 5 or more channels. The second line was charged in 60 ns and broke down with 10 to 25 channels at a mean field of 1.6 MV/cm. The closure time of each spark channel along both switches was measured with a streak camera and showed low jitter. The resulting fast pulse line construction is simpler and should provide considerable cost savings from previous designs. Multiples of these low impedance lines in parallel can be employed to obtain power levels in the 1E14 W range for REB fusion studies. 6 Refs.  
Primary Keywords: Water Switch; Self-breakdown Operation; Multichannel Operations; Experiment; Theory  
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5974  
(BREAKDOWN STUDIES)  
(Liquid, Electrical)  
NANOSECOND BREAKDOWN IN LIQUID DIELECTRICS  
P. Felsenthal  
Arthur D. Little, Inc., Cambridge, MA  
Journal Of Applied Physics, Vol. 37, No. 10, pp 3713-3715 (09/1966).  
Measurements of nanosecond formative times in various liquids are summarized. The experiments utilized applied fields of up to 3.3E6 V/cm while equipment time resolution was on the order of 0.3 nsec. Detailed results are given for n-hexane including aging time histories and formative times with and without an applied bias field. The data obtained in this study are compared with earlier work. Using a simplified breakdown model the mobility of charge carriers at 2E6 V/cm is calculated to be 8.7E-2 sq.cm/V-sec. The nanosecond high-voltage insulating qualities of various liquids are discussed.  
6 Refs.  
Primary Keywords: Formative Time Lag; Liquid Breakdown; Several Liquids; High E-field; Short Pulse Insulation  
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6024  
DESIGN STUDIES FOR ULTRA-FAST, LOW-IMPEDANCE HIGH-PEAK-POWER PULSED SYSTEMS  
J.L. Brewster, F.M. Charbonnier, L.F. Garrett, K.W. Riegelmann and J.K. Trolan  
Field Emission Corp. McMinnville, OR 97128  
Technical rept. Apr 62-Aug 65 (11/1965).  
Availability: AD-675 369/557  
NTIS  
Ultrafast pulsed power systems have proved to be effective energy sources for transducers to produce intense X rays, dense electron beams, and very high temperature plasmas. The principal function of a single shot or low repetition rate pulsed power system is to accept energy at low power levels and subsequently to deliver such energy at extremely high power levels. With maximum efficiency, to a suitable transducer. This objective can best be met by use of either distributed or lumped-constant pulse forming networks where optimum performance is realized by maintaining the proper impedance match between the power source and transducer throughout the energy delivery process. Attainment of the proper impedance match can impose stringent and sometimes contra-indicating requirements upon the dielectric storage media, the switching mechanism, and the transducer chamber. The most promising approach to such power sources appears to be a pulse-charged two-stage coaxial Blumlein system. Such a system can deliver 25 kilovolts at 2 megavolts in a pulse width of 40 nanoseconds to a suitably matched flash X-ray tube to produce relatively high dose rates with long tube life and minimal maintenance. The performance of a Blumlein exploding wire system, with respect to the rate of energy transfer, is primarily limited by the uncancelled transducer chamber impedance to the extent required to give dV/dt values close to 10 to the 14th power amp/sec for wires a few mils in diameter. Attainment  
Primary Keywords: Pulse Generators; Transducers; X Rays; Electron Beams; Plasma Medium; Impedance Matching; Electrical Impedance; Dielectric Properties; X Ray Tubes; Voltage; Switching Circuits; Power Transformers; Gas Discharges; Transmission Lines  
Secondary Keywords: NTIS000DXD  
Distribution Restriction: DISTRIBUTION LIMITATION NOW REMOVED.

6026  
(PULSE GENERATORS)  
(Triggered)  
GENERATOR PRODUCING RECTANGULAR VOLTAGE PULSES HAVING AN AMPLITUDE OF 50 KV  
S.S. Kingson and V.P. Smirnov  
Atomic Energy Institute, Moscow, USSR  
Instruments And Experimental Techniques, Vol. 16, No. 2, pp 456-457 (04/1973).  
Trans. From: Priybori i Tekhnika Eksperimenta 2, 109-110 (March-April 1973)  
A high-voltage pulse generator is described which is implemented using long lines (RK-5-9-12 coaxial cable). A trigatron with external oil insulation is used as the commutator. The generator allows a voltage pulse having an amplitude of up to 50 kV and a length of 40 nsec with a leading-edge duration of approximately 1 nsec to be obtained across a matched 50-ohm load. Results are presented of investigations of generator operation in various modes. The generator was used in circuits for synchronizing high-voltage devices. 2 Refs.  
Primary Keywords: High-voltage Pulse Generator; 50 KV Voltage Pulse Amplitude; Blumlein Line; Trigatron Switch; Rectangular Pulse Output; Nanosecond Rise Time  
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6027  
HIGH ENERGY HIGH DUTY PULSER  
Authors Unknown  
RCA Corp., Moorestown, NJ 08057  
Final technical rept. Feb 73-Feb 74. (03/1974).  
Availability: AD-780 031/1  
NTIS  
The report presents the results of a one year in-depth study on achieving a high peak energy and high average power pulser. Design objectives are for a 2.5 gigawatt peak power/10 megawatt average power pulser supplying 20 microsecond pulses at 200 pulses per second. An artificial line type modulator with hydrogen thyatron switch tubes was chosen for the pulser design. Emphasis was placed on selection of the type of switching device (hydrogen thyatrons versus spark gaps versus solid state versus mercury pool switches, etc.), and on selection of a particular device of the chosen type. Hydrogen thyatrons were chosen over competing types of switches because suitable types are available "off the shelf", whereas all of the competing types require some development work to meet the requirements. A sample pulser design, using the KU-275 hydrogen thyatron, is given.  
Primary Keywords: Pulse Generators; Thyatrons; Hydrogen; High Power; Short Pulses; Switches; Modulators; Safety  
Secondary Keywords: Design; Pulsers; NTISAF

6028  
(SWITCHES, CLOSING)  
(Systems)  
LOW-INDUCTANCE SWITCHING USING PARALLEL SPARK-GAPS  
R.A. Fitch and M.R. McCormick  
Atomic Weapons Research Establishment, Aldermaston, Berkshire, UK  
Proceedings Of The IEE, Vol. 106, Part A Supplement No. 2, pp 117-130 (11/1959).  
The parallel operation of triggered gas spark gaps is considered in this paper. The authors analyze the triggering and breakdown of trigatrons, cascade overvoltage gaps, and swinging cascade gaps when switched in parallel with transit time isolation. An extensive analysis is made of the effects of trigger voltage, trigger scatter, trigger cable impedance, load impedance, and type of gap used. Fault analysis is included. Experimental results are included for a bank at AURE (nicknamed Maggi). This bank utilized 200 trigatron switches to give a current rise of over 1E13 A/sec. 21 Refs.  
Primary Keywords: Parallel Spark Gaps; Three Spark Gap Types; Performance Test; Analysis; Trigatron; Cascade Overvoltage Gap; Field Distortion Gap  
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6034  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
SELF-CROWBARRING, LOAD-ISOLATING TRIGGERED SPARK GAP  
J.W. Robinson  
Pennsylvania State University, University Park, PA  
The Review Of Scientific Instruments, Vol. 31, No. 11, pp 1532-1534 (11/1960).  
Crowbarring is achieved when a magnetically driven arc contacts an electrode in the crowbar circuit. No auxiliary timing circuitry is required and, at the time of crowbarring, the arc divides into two parts such that the load is isolated from the source. A discharge which peaks at 200 kA in 4 microseconds is crowbarred and displays a 50-microsecond e-folding time with a ripple current of less than 5%. Main switching and crowbarring are combined in a single 3-electrode spark gap which is triggered by a pin between two of the electrodes. Crowbar timing is insensitive to gap dimensions and to current magnitude. Pin placement is critical but little energy is dissipated in the neighborhood of the trigger pin. 7 Refs.  
Primary Keywords: Triggered Spark Gap; Self-crowbarring Gap; 200 kA Peak Current; Three-electrode System; 95 nH Total Switching System Inductance  
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6035  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Vacuum, Reviews; Vacuum Gaps, Reviews)  
VACUUM ARCS AND SWITCHING  
G.A. Farrell  
General Electric Co., Schenectady, NY 12301  
Proceedings Of The IEEE, Vol. 61, No. 8, pp 1113-1136 (08/1973).  
This paper is a review of vacuum-arc phenomena which are related to switching devices. Despite the device overtones, the approach adopted for this paper is fundamental. Topics discussed include the drawn arc, the triggered arc, the power input to the cathode spot, cathode-spot division, arc stability, substructure of the cathode spot, dielectric recovery processes, and breakdown between electrodes subjected to repeated arcing. Frequent reference to the recent literature is made. Due to the somewhat specialized nature of certain parts of the discussion, introductory and appended sections of the paper present supplementary remarks on the concept of plasma and electrical conduction in gases, electron emission processes, and electrical contact phenomena. 134 Refs.  
Primary Keywords: Vacuum Breakdown; Vacuum Switching; Drawn Arc; Triggered Arc; Cathode Spot; Recovery; Electrode Conditioning; Field Emission  
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6036  
(SWITCHES, CLOSING)  
(Reviews)  
A CRITICAL ANALYSIS AND ASSESSMENT OF HIGH POWER SWITCHES  
T.R. Burkes, M.O. Hapler, M. Kristiansen, J.P. Craig, W.M. Portnoy and E.E. Kunhardt  
Texas Tech University, Lubbock, TX 79409  
Naval Surface Weapons Center Final Report On Subcontract SCEEE-SIP/77-20 (08/1978).  
This work represents an evaluation and summary of the current state-of-the-art in pulsed power switching. Specifically, tube type switches (thyatrons, ignitrons, etc.), thyristors, transistors, spark gaps, mechanical switches and various other switches are described. The emphasis is on single element devices and switch performance achieved by series-parallel combinations of small devices is not included. A comparison of the capabilities of commercially available switches is made. Switch characterization and evaluation of those parameters responsible for switching performance, including standoff voltage, peak current, dV/dt, pulse width, and pulse repetition rate, are presented. 345 Refs.  
Primary Keywords: State-of-the-art; Thyatron; Ignitron; Thyristor; Transistor; Spark Gap; Mechanical Switch; Parameter Characterization

6038  
(SWITCHES, CLOSING)  
(Gas Gaps, Optical)  
A LASER-TRIGGERED 50 PPS HIGH-VOLTAGE SWITCH WITH NANOSECOND JITTER  
A.H. Gunther and R.H. McKnight  
AFMIL, Kirtland AFB, NM 87117  
Proceedings Of The IEEE, Vol. 55, No. 8, pp 1504 (08/1967).  
A Q-switched YAG laser system was used to switch a high-voltage spark gap at rates up to 50 pps with jitter of approximately 1 ns. 6 Refs.  
Primary Keywords: Laser-triggered Spark Gap; YAG Laser; Electrode Triggering; 11-100 mJ Laser Output; Megavolt Operating Voltage; Rep-rated  
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6054  
(PULSE GENERATORS; POWER CONDITIONING; SWITCHES; CLOSING; SWITCHES; CLOSING)  
(Capacitors; Pulse Transformers; Gas Gaps; Electrical; Avalanche Transistors; Electrical)  
SPARK CHAMBER PULSING SYSTEM  
L. Lavoie, S. Parker, C. Ray and D.M. Schwartz  
University of Chicago, Chicago, IL  
The Review Of Scientific Instruments, Vol. 35, No. 11, pp 1567-1571 (11/1964).  
A spark chamber pulser is described in which several avalanche transistors and a step-up transformer drive directly an air spark gap whose trigger electrode is surrounded by barium titanate dielectric. Output pulses of iron 1 to 25 kV with a risetime of 1 nsec and an output impedance of less than 1 ohm can be obtained. The total delay from the 1-V input pulse to the high voltage output pulse ranges from 17 to 65 nsec dependent on the desired voltage and the mode of operation of the spark gap. Jitter times are less than 3 nsec. When Elkonite-tipped electrodes are used, the gap life is in excess of 5000000 pulses. Methods are given for reducing the delay to less than 25 nsec at 20 kV and the recovery time to less than 200 microseconds at 10 kV. 12 Refs.  
Primary Keywords: Spark Chamber Pulser; 1 To 25 kV Output Pulses; <1 Ohm Output Impedance; >5 Million Pulses Gap Life; Spark Gap; Avalanche Circuit; Low Delay; Nanosecond Jitter; Elkonite Electrodes  
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6055  
(ENERGY STORAGE; CAPACITIVE; SWITCHES; CLOSING)  
(Capacitor Banks; Gas Gaps; Electrical)  
SPARKING OF A 384-KJ LOW INDUCTANCE CAPACITOR BANK  
L.M. Goldman, H.C. Pollock, J.A. Reynolds and W.F. Westendorp  
General Electric Co., Schenectady, NY 12301  
The Review Of Scientific Instruments, Vol. 33, No. 10, pp 1041-1044 (10/1962).  
A three-electrode spark gap which can handle high energy (96 kJ) has been designed and used with a 384 kJ capacitor bank having an operating range from 30 to 60 kV. The gap jitter time has been reduced to less than 25 nsec. During theta-pinch experiments involving 3000 discharges of the bank, there has been no significant deterioration of the gaps or variation of the electrical characteristics of the system. 10 Refs.  
Primary Keywords: Spark Gap; 384 kJ Capacitor Bank; <25 nsec Gap Jitter; Low Inductance Bank; Life Test  
Secondary Keywords: Theta-pinch  
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6057  
(SWITCHES; CLOSING)  
(Gas Gaps; Electrical)  
TRIGGERING MECHANISM OF LOW-PRESSURE SPARK GAPS  
R. Hancox  
Culham Lab. Abingdon, Oxfordshire, UK  
The Review Of Scientific Instruments, Vol. 33, No. 11, pp 1239-1244 (11/1962).  
The triggering delay in two low-pressure spark-gap switches, operating in the pressure range 1E-3 to 3E-2 mm Hg, has been measured under a wide range of conditions. When the trigger pin is in the negative electrode, the delay is found to consist of two components. The first part depends on the construction of the trigger pin, the trigger voltage, and the impedance of the trigger circuit, while the second part depends on the nature and pressure of the gas in the gap, and the voltage and impedance of the circuit being switched. If the trigger pin is in the positive electrode a further delay is added which is approximately equal to the transit time of an ion across the gap. A mechanism for the breakdown is proposed which is consistent with the measurements and with previously reported results. 3 Refs.  
Primary Keywords: Spark Gap; Triggering Mechanism; Low-pressure Spark-gap; 1E-3 To 3E-2 mmHg Pressure Range; Triggering Delay Measurements; Critical Pressure; Breakdown Modeling  
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6060  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES)  
(Vacuum; Electrical; Electrodes)  
A MEANS OF RAISING THE THRESHOLD CURRENT FOR ANODE SPOT FORMATION IN METAL-VAPOR ARCS  
J.A. Rich  
General Electric Co., Schenectady, NY 12301  
Proceedings Of The IEEE, Vol. 59, No. 4, pp 539-545 (04/1971).  
Of the various processes occurring in an arc at high currents one of the most important with regard to application is the formation of an anode spot and the consequent melting associated with it. Various arc devices depend for their operation on the formation of a high current transient metal-vapor arc. The limiting current in a particular design may be set by destructive melting at the anode. It is shown that it is possible to raise the threshold current for anode spot formation in a metal-vapor arc by suitably changing the electrode geometry. From a study of a few simple electrode geometries a set of guidelines has been evolved governing the choice of electrode geometry. As an illustration of the efficacy of these guidelines and the means of implementing them in practice it is shown how it is possible, with successive modifications of a coaxial-cylindrical electrode structure, to attain a peak current of 72 kA for a damped 60-Hz current wave without electrode melting. 5 Refs.  
Primary Keywords: Vacuum Breakdown; High-current Arc; Anode Spot; Anode Melting; Operation Limitations; Electrode Geometry Selection; Design Considerations  
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6064  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES)  
(Electrodes; Vacuum; Electrical)  
ANODE PHENOMENA IN METAL-VAPOR ARCS AT HIGH CURRENTS  
J.A. Rich, L.E. Prescott and J.D. Cobine  
General Electric Co., Schenectady, NY 12301  
Journal Of Applied Physics, Vol. 42, No. 2, pp 587-601 (02/1971).  
The present investigation is concerned with the conditions associated with the development of an anode spot for metal-vapor (vacuum) arcs. Chief among the aims of the investigation is the determination of the threshold current density for anode spot formation for a variety of electrode materials spanning a wide range of thermal and electrical properties. Electrodes of Sn, Al, Ag, Cu, Mo, and W were chosen for study in a plane-parallel electrode geometry. Arcing was over one-half cycle of a 60-Hz current wave. The onset of anode spot formation was determined from high-speed streak photographs of the discharge. An oscillographic record of the arc voltage was obtained simultaneously with the streak picture. From the data obtained particular interest attaches to the threshold current for anode spot formation, the threshold current density derived from it, and the arc voltage current characteristic. In general, high-current metal-vapor arcs have positive volt-ampere characteristics and exhibit an hysteresis effect. Rapid changes in arc voltage, noise voltage, and in the magnitude of the hysteresis effect are associated with the formation of an anode spot. The noise voltage and arc drop decrease as the spot develops. 13 Refs.  
Primary Keywords: Vacuum Breakdown; Anode Spot; Spot Formation; Threshold Current; Several Anode Materials; Plane-parallel Electrodes; Voltage Variations  
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6067  
(SWITCHES; CLOSING)  
(Ignitrons)  
BEHAVIOR OF THE RESISTANCE IGNITOR IN MERCURY  
W.W. Rignod  
Westinghouse Electric Corp., Bloomfield, NJ  
Journal Of Applied Physics, Vol. 42, No. 6, pp 787-796 (06/1971).  
An empiric expression has been derived for the probability of arc striking per unit time, per unit length of contact perimeter, for a resistance ignitor in a mercury-pool tube.  $P = K(E - E_{sub})^2 / (E_{sub})^2$ , where  $P$  is the probability of arc striking per unit time, per unit length of contact perimeter,  $E$  is the electric field strength near the mercury surface, and  $E_{sub}$  is the resistivity of ignitor material at the junction with the mercury. From the foregoing, a formula has been established for the probability of ignition per unit time, for the entire ignitor, in terms of the applied voltage and ignitor firing resistance  $R$ . With this formula, whose two arbitrary constants can be determined by two sets of measurements, the firing voltage of any ignitor can be predicted under a wide variety of circuit conditions, provided  $R$  remains unchanged under these conditions. The probability formula was found to be consistent with a modification of a theory advanced by L. Tonks, whereby mercury surface distortion and rupture permit field emission at field strengths less than those effective for smooth surfaces. The modification attributes the reduction in ignitor firing voltage by ignitor current to its extremely localized ohmic heating of the mercury. This heating reduces the surface tension and roughens the mercury surface, thereby accelerating the process of surface rupture by the electric field. 12 Refs.  
Primary Keywords: Ignition Switch; Ignition Characteristics; Resistance Ignitor; Ignition Probability; Geometry Considerations; Empirical Formula  
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6068  
(BREAKDOWN STUDIES)  
(Electrodes)  
CATHODE DARK SPACE AND NEGATIVE GLOW OF A MERCURY ARC  
C.G. Smith  
Raytheon Manufacturing Co., Newton, MA  
Physical Review, Vol. 69, No. 3-4, pp 96-100 (02/1946).  
Means were evolved to observe the cathode dark space of the mercury arc, the object being to measure the thickness and evaluate therefrom the voltage gradient at the cathode to distinguish between field and emission theories of electron liberation. A magnetic field transverse to the arc drives it in the opposite direction to the force involved. This wrong way motion made it possible to race the arc spot over scratch mercury while ions, electrons, and vapor were blown rearward. Photomicrographs showed a negative glow, its image in the mercury, and a space between; evidently twice the dark space. A one-atmosphere arc had a dark space of 0.001 cm; a hundred times too large for the field theory, and causing excessive space charge limitation of current unless compensating ionization occurs throughout said space. Phenomena in the negative glow must cause the needed ionization and also intensive electronic bombardment of the cathode. This is assumed to cause cumulative excitation of the liquid resulting in emission of electrons and light. A continuous spectrum originates within the limits of measurement at the liquid. 12 Refs.  
Primary Keywords: Mercury Arc Cathode Spot; Spot Motion; Negative Glow; 0.001 cm Cathode Dark Space; 1000 V/cm Gradient; Transverse Magnetic Field; Field Emission  
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6070  
(INSULATION; MATERIAL)  
(Liquids)  
DETERMINATION OF HIGHLY STRESSED VOLUMES IN OIL DIELECTRICS  
P.W. Birke, J. Lackey and S. Palmer  
Westinghouse Canada Ltd., Hamilton, Ontario, Canada  
IEEE Transactions On Electrical Insulation, Vol. EI-7, No. 3, pp 159-164 (04/1972).  
The volume of oil under the highest stress has been shown to correlate well with the measured breakdown voltages of transformer bushing electrode systems. The determination of the volume of oil that is most highly stressed in a given electrode system is not however an easy matter. It involves the location of equistress or nonuniform surfaces followed by computation of the oil volume contained within the surfaces. This paper describes a differential probe and amplifier system, which has been developed to allow the direct plotting of nonuniform gradient lines on a conducting paper analog of any two-dimensional electrostatic field. 15 Refs.  
Primary Keywords: Oil Insulation; Electrical Stress Calculation; Volume Effects; Several Geometries; Equipotential Surface  
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6071  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES)  
(Vacuum, Electrical; Electrodes)  
ELECTRON EMISSION IN INTENSE ELECTRIC FIELDS  
R.H. Fowler and L. Nordheim  
Proceedings Of The Royal Society Of London, Vol. A119, pp 173-181  
(01/1928).  
In this paper, Fowler and Nordheim build upon the accomplishments of others in an attempt to improve the theoretical exposition and the correlation with experiments in relation to the process of extracting electrons from cold metals by intense electric fields. They have included the effect of an external field and have established a formula for currents which is independent of  $T$  at low temperature and concurs with experiment. In addition, the emission coefficients for electrons of given energy in a uniform external field are calculated. It is shown for the most commonly used metals that emission should occur for fields  $>10^7$  volts/cm. 12 Refs.  
Primary Keywords: Field Emission; Thermionic Emission; Intense Electric Fields; Electron Emission; Emission Coefficients; Potential Energy Step; Theory  
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6076  
(INSULATION, MATERIAL; BREAKDOWN STUDIES)  
(Solid; Surface Flashover)  
HIGH VOLTAGE INSULATORS FOR PARTICLE ACCELERATORS  
K.D. Srivastava  
University of Waterloo, Waterloo, Ontario, Canada  
IEEE Transactions On Nuclear Science, Vol. NS-16, No. 3, pp 111-112  
(06/1969).  
In modern high energy particle accelerators there are many component parts and devices which operate at high voltages in vacuum, e.g., injectors, inflectors, beam choppers and velocity separators. Since the surface voltage stress attainable across insulators is generally lower than across plane gaps, the physical size of the apparatus is governed by the high voltage performance of the support insulators in vacuum. In this paper the author discusses the various factors affecting the insulator performance, in the light of his experience with NIPROD, the 7 BeV proton synchrotron and the design of a DC injector for an intense neutron generator machine which was under study at Chalk River, Canada. 4 Refs.  
Primary Keywords: High Voltage Insulators; Insulator Flashover; Particle Accelerator; Field Emission; Insulator Charging; Gas Evolution; Breakdown Factors  
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6080  
(BREAKDOWN STUDIES)  
(Electrodes)  
MOTION AND SPECTRUM OF ARC CATHODE SPOT IN A MAGNETIC FIELD  
R.M. St. John and J.G. Winans  
University of Wisconsin, Madison, WI  
Physical Review, Vol. 98, No. 6, pp 1664-1671 (06/1955).  
The velocity of the cathode spot of a mercury arc at the junction between liquid and metal in a transverse magnetic field has been measured for magnetic field strengths between 0 and 20700 oersteds. The approximate doubling of retrograde velocity at about 11000 to 15000 oersteds was followed by an additional rapid rise of velocity at about 15000 oersteds. Spectra of the arc showed Hg II and Hg III lines at the stronger magnetic fields. Radiation from the cathode spot showed mercury lines and a continuous spectrum which is especially intense at the lines. Some Hg lines are broadened symmetrically and others asymmetrically. If the broadening is due to a Stark effect, the electric field strength in the cathode spot region is greater than  $666$  volts/cm. The arc mechanism previously proposed is extended to explain the rapid velocity rises with increasing magnetic field strength by associating them with the effect of Hg/sup +/ and Hg/sup ++/ ions. 12 Refs.  
Primary Keywords: Cathode Spot Motion; Transverse Magnetic Field; >6E6 Volts/cm Electric Field Strength; Cathode Spot; Mercury Velocity Rises; Spectroscopic Diagnostic; Mercury Cathode  
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6081  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Liquid, Electrical; Ignitrons)  
ON ANCHORING THE MERCURY POOL CATHODE SPOT  
L. Tonks  
General Electric Co., Schenectady, NY 12301  
Physics, Vol. 6, No. 9, pp 214-205 (09/1935).  
This paper presents results of an experiment designed to observe the anchoring of the spot in a mercury cathode by several metals projecting through the surface of the mercury pool. Fe, Pd, Zn, Pt, Cr, Co, Ir, Mo, Ta, and W were all tried with varying results. The current in the spot is seen to have a marked effect on behavior. The spot is seen to become a fine line around the meniscus of the projection. 7 Refs.  
Primary Keywords: Cathode Spot Anchoring; Cathode Line; Mercury Pool; Limited Cathode Line Length; Several Anchoring Materials  
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6091  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES)  
(Gas, Electrical; Gas, Recovery)  
THE APPLICATION OF PASCHEN'S LAW TO THE RE-IGNITION OF AN APC  
J.D. Cobine and R.B. Power  
Harvard University, Cambridge, MA  
Journal Of Applied Physics, Vol. 8, No. 4, pp 287-290 (04/1937).  
An AC arc, in order to restrike after passing through current zero, requires a potential considerably higher than the normal burning potential. This re-ignition potential is investigated for short gaps in nitrogen, using pure graphite electrodes with spacings up to two mm and pressures up to 500 cm Hg. The re-ignition potential is found to have two characteristics. One of these characteristics is followed for the arcs in which the cathode spot is maintained by field emission, and the other is followed for the "thermionic" arc. Relations are obtained between this re-ignition potential and both the gas pressure and the gap spacing, with the arc current as a parameter. These relations may then be combined into a single relation between the re-ignition potential and the product of the pressure and spacing. This gives a function that is of the same form as the Paschen law for the initial sparking potential of a gap. 10 Refs.  
Primary Keywords: Paschen's Law; Arc Re-ignition; Extreme Electrode Materials; Re-ignition Potential; Gap Separation; Gas Pressure  
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6097  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Gas, Electrical; Ignitrons)  
THE PRODUCTION OF HIGH VELOCITY MERCURY VAPOR JETS BY SPARK DISCHARGE  
J.R. Haynes  
Bell Labs, Murray Hill, NJ 07974  
Physical Review, Vol. 73, No. 8, pp 891-903 (04/1948).  
Photographs of sparks of microsecond duration in hydrogen to a mercury electrode show high velocity jets from the mercury surface regardless of polarity. Spectroscopic examination shows that these jets are largely composed of mercury atoms which sweep away the hydrogen. Measurements of jet velocity demonstrate that it is independent of current and gas pressure over a wide range. While it decreases with distance from the source, the original velocity of the cathode jet is  $1.9E5$  cm/sec., and that of the anode jet is  $1.5E5$  cm/sec. The energy of the anode jet can be accounted for by positive mercury ions crossing the anode drop. It appears that the energy of the cathode jet cannot be accounted for unless it is assumed that, in addition to positive ions striking the cathode and rebounding as neutral atoms, many mercury atoms leave the cathode as negative ions. 20 Refs.  
Primary Keywords: Hydrogen Breakdown; Mercury Electrode; Mercury Vapor Jet; Jet Velocity; Microsecond Time Scale; Spectroscopic Diagnostic  
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6103  
(SWITCHES, CLOSING)  
(Thyratrons)  
CATHODE-CURRENT DEPENDENCE ON PULSE WIDTH FOR HYDROGEN THYRATRON  
J.E. Croeden  
ECM, Fort Monmouth, NJ 07703  
IEEE Transactions On Communications And Electronics, Vol. 83, No. 74, pp 582-585 (07/1966).  
It is well known that the oxide-coated cathode in a well-activated hydrogen thyatron is capable of sustaining a current density in excess of  $20$  A/sq.cm. for pulse durations of 1 microsecond or less. It is also known that, as the pulse length increases, the emission density at which arcing occurs decreases. The current capabilities of oxide-coated cathodes in hydrogen thyratrons were experimentally evaluated at pulse lengths of 5, 30, 110, and 1,000 microseconds, and a number of different tube sizes were used. At a constant pulse width, it was found that the current density at which arcing occurred was related to the cathode-coating resistance and that the limiting factor was a maximum power-dissipation density; the power density at which arcing occurred was related to the pulse length. The use of this dependence to determine the cathode current capability at any pulse width is discussed. 1 Refs.  
Primary Keywords: Cathode Effects; Long Pulse Lengths; Breakdown Voltage vs Pulse Length; Several Thyatron Sizes  
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6106  
(SWITCHES, CLOSING)  
(Thyratrons)  
DEVELOPMENT OF A HYDROGEN THYRATRON HAVING A LONG PULSE CAPABILITY  
D. Dolbear (1), D. Fleischner (1), S. Merz (1), R. Plante (1), D. Tarnau (1) and N. Reinhardt (2)  
(1) EG&G Inc., Salem, MA 01970  
(2) Consultant, Lexington, MA  
1978 IEEE Thirteenth Modulator Symposium, pp 117-124 (06/1978).  
A hydrogen thyatron is being developed which is capable of switching 80 amperes at 100 kilovolts with the additional and unusual requirement that the pulse width be as long as 30 seconds with a 10 percent duty cycle. Thyatron operation under these relatively long pulse conditions at moderate current levels represents a unique class of thyatron service, requiring significant departures from standard thyatron design practices. Radical departures from standard cathode design are necessary to ensure effective utilization of the cathode at the required cathode current on the long time scales involved. In addition, energy losses which occur both in the cathode plasma and at the grid structure integrate over the duration of the current pulse, and the resulting high transient heating must be considered and controlled. The need for a conservative 100-kilovolt anode holdoff capability necessitates the use of a multipier-section high voltage holdoff structure, and this need is complicated by an additional requirement that high voltage recovery be achieved within 100 microseconds. The various aspects of the overall tube design are reviewed and the design approach is discussed. Experimental results are presented and consideration is given to the external circuitry associated with the tube in its intended environment, a neutral beam beam supply for a magnetic plasma confinement fusion application. 4 Refs.  
Primary Keywords: Ceramic Thyatron; Long Pulse; New Cathode Design  
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6109  
METAL-OXIDE DEVICES FOR RAPID HIGH CURRENT SWITCHING  
G. Gaudin, P. LaPlante, S. Low and S. Schneider  
ECM, Fort Monmouth, NJ 07703  
(01/1975).  
Availability: AD-A355 135/65T  
NTIS  
No abstract available.  
Primary Keywords: Switching Circuits; Suppressors; Pulse Generators; High Voltage; Reprints  
Secondary Keywords: Niobium Diacide, NTISDDXXR  
Distribution Restriction: AVAILABILITY: PUB. IN IEDM TECHNICAL DIGEST, P271-282 1976

6110  
(SWITCHES, CLOSING)  
(Thyratrons)  
MULTI-MEGAWATT HYDROGEN THYRATRON WITH NANO-SECOND RISE TIMES  
S. Friedman, J. Goldberger, J. Hamilton, S. Merz, R. Plante and D. Tarnau  
EG&G Inc., Salem, MA 01970  
1978 IEEE Thirteenth Modulator Symposium, pp 129-134 (06/1978).  
A new and advanced class of high power hydrogen thyatron is being developed which is capable of switching very short and ultra fast rising multi-megawatt pulses. The effort underway is to extend the operating range of thyratrons to values of di/dt and current rise time an order of magnitude faster than heretofore achieved, and to do so at high voltages, peak currents, and repetition rates. Immediate goals are di/dt of  $1E12$  A/s with a 5 ns rise time, peak currents of up to 75 kA, pulse repetition rates of 1 kHz, and forward voltage holdoff of 50 kV for a single section tube and up to 250 kV for a quadrant grid tube. Retention of the usual advantages of thyatron switches (stable operation, fast recovery time, and long life), is essential in order to meet various other requirements imposed on these tubes in their applications. This paper describes some of the progress that has been encountered and the progress we have made in this previously uninvestigated regime of thyatron operation. 3 Refs.  
Primary Keywords: Ceramic Thyatron; Fast Rise; Short Pulse; High Current; High Repetition Rate; Analysis Of Discharge Formation  
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6154  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
MONTE CARLO SIMULATION OF THE LOW-VOLTAGE ARC MODE IN PLASMA DIODES  
S. N. Solinger and J. E. Rowe  
University of Michigan, Ann Arbor, MI  
Journal Of Applied Physics, Vol. 39, No. 8, pp 3933 (07/1968).  
A statistical simulation of the low-voltage arc mode of plasma diodes is carried out on a large-scale digital computer to ascertain the importance of various thermalization and transport mechanisms. The computer experiment is two-dimensional and utilizes Monte Carlo techniques to study the low-voltage arc in neon at  $p=2$  Torr, current  $=4$  A, and diode spacing  $=2.37$  cm. Results on the potential distribution, electron-density distribution, and electron-energy density function are presented and discussed. The theoretical results are correlated with experimental results. 6 Refs.  
Primary Keywords: Plasma Diode; Low Voltage Arc; Theory; Numerical Calculation; 2-d Monte Carlo Simulation  
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6158  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
PLASMA PROPERTIES OF KILOAMPERE DISCHARGES  
J. E. Creeden  
ECOM, Fort Monmouth, NJ 07703  
IEEE Transactions On Electron Devices, Vol. ED-15, No. 6, pp 396-402 (06/1968).  
Plasma properties and characteristics that are of interest to high-current switching devices have been investigated. Peak pulse currents up to 8000 amperes have been used to generate dense plasmas in linear glass-metal diodes. Two tube diameters, 3 and 7.5 inches, have been studied. In the case of the 3-inch-diameter diode, the electrode separation was varied from 10.6 to 25.1 cm. Hydrogen gas was studied in the pressure range from 0.5 to 40 Torr. Electron densities and temperatures have been determined using spectroscopic techniques. Densities were found to be in the  $1E16$  to  $1E17$  per cu. cm. range. Plasma resistivities have been determined from a knowledge of the density and temperature. The observed dependence of resistivity on current and pressure is discussed and the results are compared with resistivities obtained from tube-drop measurements. The effects of impurities and instabilities are also discussed. 8 Refs.  
Primary Keywords: Hydrogen Breakdown; 80 kA Current Level; Glass-metal Diode; 5-40 Torr Pressure Range; Plasma Density; Plasma Resistivity; Impurity Effects  
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6174  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
NANOSECOND PULSED ELECTRON ACCELERATOR  
T. Yamamoto, J. Ohkuma and M. Kawanishi  
Osaka University, Suita, Osaka, Japan  
The Review Of Scientific Instruments, Vol. 42, No. 9, pp 1366-1367 (09/1971).  
An electron accelerator that can deliver a pulsed electron beam of the shortest duration and highest energy and current possible is desirable in many fields of research, especially in studying the fast transient phenomena in radiation physics and chemistry. In general, pulsation of the electron beam is usually performed by supplying a pulsed gating-voltage from a coaxial line-type pulser, hard tube pulser, or pulse shaper to the grid of the gun. A unique electron accelerator which satisfies the above mentioned conditions has been developed and the characteristic features of the device are reported in the present note. 3 Refs.  
Primary Keywords: Electron Gun; Mercury Relay; Short Pulse; Low Current  
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6211  
ELECTROMECHANICAL PULSE GENERATORS  
E. Levi  
Polytechnic Institute of New York, Brooklyn, NY 11201  
Research rept. No. R-751-59, 40p (07/1959).  
Availability: AD-220 852/85T  
NTIS  
No abstract available.  
Primary Keywords: Electromechanical Converters; Pulse Generators; Design; Radar; Inermuclear Reactions  
Secondary Keywords: NTISDDDD  
Distribution Restriction: DISTRIBUTION LIMITATION NOW REMOVED. NOTE: ONLY 35MM MICROFILM IS AVAILABLE. NO MICROFICHE

6288  
(PULSE GENERATORS; PULSE GENERATORS; PULSE GENERATORS)  
(LC; Spiral; Stacked Line)  
NOVEL PRINCIPLE OF TRANSIENT HIGH-VOLTAGE GENERATION  
R. A. Fitch (1) and V. T. S. Howill (2)  
(1) United Kingdom Atomic Energy Authority  
(2) Bover, Long Electronics Ltd.  
Proceedings Of The IEE, Vol. 111, No. 4, pp 849-855 (04/1964).  
The authors discuss a class of pulse generator in which several sections are charged to opposite polarity to produce a net voltage of zero. The sections are then discharged in series such that the inductive delays effect a voltage reversal in one-half of sections to provide voltage multiplication. This method of multiplication is termed voltage inversion by the authors. Stacked-line, LC, and spiral generators are discussed as members of this class of generator. 13 Refs.  
Primary Keywords: Voltage Inversion Pulse Generator; Voltage Multiplication; Stacked-line Pulse Generator; LC Pulse Generator; Spiral Pulse Generator  
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6297  
(BREAKDOWN STUDIES; INSULATION, MATERIAL)  
(Liquid; Electrical; Liquid)  
THE INFLUENCE OF DISSOLVED GASES ON THE ELECTRIC STRENGTH OF N-HEXANE  
A. M. Slaten and T. J. Lewis  
Queen Mary College, London, UK  
British Journal Of Applied Physics, Vol. 14, pp 883-888 (12/1963).  
The electric strength of n-hexane for steady fields (direct strength) is found to increase from 0.7 MV/cm and to become insensitive to electrode material as the amount of dissolved oxygen is increased to an equilibrium partial pressure of 100 mmHg in the vapour phase above the liquid. Greater amounts do not increase the strength. Nitrogen, hydrogen and carbon dioxide have no effect even when large amounts are dissolved, except that repeated discharges when carbon dioxide is present cause the strength to rise, probably because of the release of oxygen. Unless the liquid has been pre-stressed with direct voltage of opposite polarity, the strength with 1.5 microsecond pulses is not affected by dissolved gas. Immediately after pre-stressing, however, the strength with pulses may be as great as 2.5 MV/cm. Dust particles of the order of 1 micron in size are always observed in the liquid and under direct stress pass to and fro between the electrodes. This activity is reduced by the addition of oxygen. With high oxygen concentrations the visible particles are sometimes observed to be expelled from the gap and strengths up to 2 MV/cm are then recorded. Oxygen, being electronegative, is likely to cause the formation of negative ions. It is suggested that these ions can inhibit the breakdown and lead to higher strengths with direct voltage and also with pulses if the liquid has been previously stressed with direct voltage of opposite polarity. 19 Refs.  
Primary Keywords: N-hexane; Dissolved Gas; Oxygen Gas; Increased Dielectric Strength; Several Gases; No Effect; Dust Particles  
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6319  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
THE STEP VOLTAGE DROP ACROSS A SPARK WITH A PULSE DISCHARGE IN THE NANOSECOND RANGE  
L. G. Bychkova, Yu. I. Bychkov and G. A. Masys  
Soviet Physics Journal Vol. 10, No. 12, pp 75 (12/1967).  
Trans. From: Izvestiya VUZ, Fizika 10, 116-147 (1967)  
The step voltage drop across a spark when there is a static breakdown was first observed by Rogowski and his colleagues. A survey of the work on the voltage steps of sparks in gases with a static breakdown for values of  $E/P < 100$  V/cm Torr is given. The cause of this phenomenon has not been definitely established, so that interest in its study continues. Most authors connect the presence of steps with a transition from a Townsend type of discharge to a streamer type. 5 Refs.  
Primary Keywords: Townsend Discharge; Streamer Breakdown; Discontinuous Voltage Drop; UV Radiation  
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6322  
(ENERGY STORAGE)  
(System Protection)  
ENERGY CONTROL FOR MICROWAVE AMPLIFIER ARRAYS  
G. W. Taylor and S. Schneider  
ECOM, Fort Monmouth, NJ 07703  
IEEE Transactions On Aerospace And Electronic Systems, Vol. AES-4, No. 5, pp 659-664 (09/1968).  
In large systems using microwave amplifier arrays, the size, weight, and cost of individual energy sources require consideration of the use of a common power supply and energy storage bank. Complex energy control techniques may be necessary to protect the RF amplifier and to provide isolation of the faulted amplifier from the common energy source. Four approaches are discussed. Three of these are dependent on either the development of reliable arc-free microwave amplifiers or special isolator tubes, gas or vacuum types. A practical circuit using available components is suggested. Its advantages and limitations are discussed. Calculations are presented showing this approach can result in increased system efficiency, improved regulation, and large decreases in the size of the secondary capacitance bank for each microwave amplifier. 3 Refs.  
Primary Keywords: Amplifier Array; Common Power Supply; Fault Protection; Efficiency Considerations; Voltage Regulation  
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6336  
(BREAKDOWN STUDIES)  
(Vacuum; Electrical)  
INFLUENCE OF HYDROGEN ON MULTIPLE-ELECTRODE (VACUUM) GAP CHARACTERISTICS  
S. Schneider, A. J. Buffa and J. E. Creeden  
ECOM, Fort Monmouth, NJ 07703  
Journal Of Applied Physics, Vol. 40, No. 1, pp 424-425 (01/1969).  
The influence of a low pressure of hydrogen on the voltage hold off and breakdown characteristics of a multiple-electrode triggered vacuum gap has been investigated. The tube is designed for 300 kV operation. The tube characteristics were studied under vacuum and at several hydrogen fill pressures at voltages from 10-300 kV. 1 Refs.  
Primary Keywords: Vacuum Breakdown; Effect Of Hydrogen Gas; Current Measurement; Voltage Measure; Variable Hydrogen Pressure  
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6362  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
A NANOSECOND RISETIME MEGAVOLT VOLTAGE DIVIDER  
D. G. Hallinen and S. Maurin  
Physic International Co. San Leandro, CA 94577  
The Review Of Scientific Instruments, Vol. 42, No. 6, pp 824-831 (06/1971).  
A well linear resistive voltage divider has been used in vacuo for measuring pulsed voltages exceeding 1 MV on electron accelerators. The monitor appears to be linear until breakdown and has a bandwidth greater than 60 Hz-150 MHz. A method of correcting for nonconservative induced potentials is described as well as several independent calibration methods. 4 Refs.  
Primary Keywords: Resistive Voltage Divider; Vacuum Environment; 150 MHz Bandwidth; Calibration Consideration; Nonconservative Induced Potential  
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6353  
(POWER CONDITIONING; SWITCHES, CLOSING; SWITCHES, OPENING)  
(Metal Oxide Switches; Miscellaneous Solid State; Miscellaneous Solid State)  
PULSE SHARPENING WITH METAL-OXIDE BULK SWITCHING DEVICES  
G.K. Gauler, R.K. LaPlante, S. Levy and S. Schneider  
ECOM, Fort Monmouth, NJ 07703  
1976 IEEE Pulsed Power Conference Proceedings, Paper IC-6 (11/1976).  
Certain niobium oxide (NbO/sub x/, x approximately 2) materials are near insulating at room temperature but undergo an "insulator-to-metal" transition near 800 Deg.C. A similar transition can be initiated at room temperature by applying an electric field exceeding the "threshold" value, which depends on the oxygen concentration (x) of the NbO/sub x/. Metal-oxide threshold switch (MOTS) prototypes are obtained by applying appropriate contacts and packaging. Threshold voltages range from 100 V to several kV. A typical MOTS has a surge current capability exceeding 100 A, an off-state capacitance of only a few pF, and a switch delay of less than 0.5 ns. The latter two characteristics make the MOTS potentially superior to conventional devices for a number of high-speed, high-current switching functions. In particular, insertion of a MOTS into the output circuit of a conventional pulse generator can "sharpen" the leading edge of the pulse to yield a ns or even sub-ns rise time. 6 Refs.  
Primary Keywords: Metal-oxide Bulk Switching Device; Pulse Sharpening; Fast Closing; Low Current; Switching Threshold  
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6358  
(SWITCHES, CLOSING)  
(Vacuum Gaps, Electrical)  
TRIGGERED VACUUM GAPS  
J.M. Lafferty  
General Electric Co, Schenectady, NY 12301  
Proceedings Of The IEEE, Vol. 54, No. 1, pp 23-32 (01/1966).  
Characteristics of a sealed vacuum gap are described and the difficulties encountered in applying this gap as an overvoltage protection device are discussed. It is shown how these difficulties can be ameliorated by the use of gas-free electrode materials and by triggering the gap when breakdown is required. Several methods of triggering are discussed and some practical triggering devices are described that inject minute quantities of ionized hydrogen into the gap. The hydrogen is eventually recovered by the use of a titanium hydride getter. It is shown that breakdown of the gap can be accomplished in less than one-tenth microsecond by first producing a glow discharge that is rapidly transformed into a metal-vapor arc. Properties of the metal-vapor arc are described which have an effect on the characteristics of the vacuum gap. A number of practical sealed-off triggered vacuum gaps are illustrated. These are used to carry microsecond capacitor discharge currents and 60-cycle power line currents for 1/2 cycle. The operating voltage range is from a few hundred volts to 100 kV. The advantages of vacuum gaps over gas-filled gaps are given and a number of overvoltage protection and switching applications are listed. 29 Refs.  
Primary Keywords: Overvoltage Protection; Electrode Effects; Several Triggering Methods; Plasma Gun Trigger; Practical Consideration  
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6376  
(SWITCHES, CLOSING)  
(Gaps, Electrical)  
A SIMPLE SWITCHING SYSTEM FOR REPEATABLE PULSED DISCHARGES  
F.L. Curzon (1) and K. Dimoff (2)  
(1) University of British Columbia, Vancouver, British Columbia, Canada  
(2) University of Alberta, Edmonton, Alberta, Canada  
Journal Of Physics E: Scientific Instruments, Vol. 3, pp 153-154 (02/1970).  
A switching system has been designed to operate with an overall jitter of 0.2 microsec in current breakdown for a 5.7 kJ pulsed discharge. Reproducibility can be sustained for up to 70 consecutive firings. Consisting of two inexpensive open air spark gaps built from readily available materials, the system functions reliably with a minimum of maintenance. 2 Refs.  
Primary Keywords: Triggering Gap; Good Reproducibility; Brass Electrodes; Atmospheric Air Gap  
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6432  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
INTENSE ELECTRON-BEAM PINCH FORMATION AND PROPAGATION IN ROD PINCH DIODES  
R.A. Mahaffey, J. Golden, S.A. Goldstein and G. Cooperstein  
Naval Research Lab, Washington, DC 20375  
Applied Physics Letters, Vol. 33, No. 9, pp 795-797 (11/1978).  
Intense electron-beam pinches are formed and propagated at moderate impedance (5-25 ohm) using rod pinch diodes. Pinch propagation of up to 20 cm with 45% efficiency and ion-generation efficiency >15% has been observed. 16 Refs.  
Primary Keywords: Intense Electron-beam Pinches; 5-25 Ohm Impedances; Rod Pinch Diodes; 20 cm Pinch Propagation; 20 cm/s Pinch Velocity; Diode Damage; Ion Formation  
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6433  
(PULSE GENERATORS; ENERGY STORAGE, CHEMICAL)  
(Flux Compression Generators)  
LIMITING CAPABILITIES OF A PLANAR EXPLOSIVE MAGNETIC GENERATOR AS A PULSED ENERGY SOURCE  
L.S. Gerasimov and V.I. Ikrvannikov  
Soviet Physics-Technical Physics, Vol. 24, No. 7, pp 841-844 (07/1979).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 49, 1513-1519 (July 1979).  
The limiting capabilities of a planar explosive magnetic generator are studied: the voltage, the power, and the energy for operation with inductive and resistive loads. The possibility of constructing module and cascade explosive systems with energies up to 100 MJ is studied. A corresponding calculation method is proposed. The theory is compared with experiment. 10 Refs.  
Primary Keywords: Flux Compression Generator; Resistive Load; Inductive Load; Modular Approach; 100 MJ Output; Analysis  
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6436  
(BREAKDOWN STUDIES)  
(Surface Flashover)  
SURFACE BREAKDOWN OF A SOLID DIELECTRIC IN VACUUM. III. QUANTITATIVE MODEL  
A.A. Avdienko and M.D. Malav  
Institute Of Nuclear Physics, Academy of Sciences of the USSR, Novosibirsk, USSR  
Soviet Physics-Technical Physics, Vol. 24, No. 5, pp 581-587 (05/1979).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 49, 987-998 (May 1979).  
A method is described for the analysis of surface breakdowns. This method is based on a desorption model proposed earlier. The dielectric strength calculated as a function of the length of the insulator and the angle between its surface and the field direction agree with experimental data reported by various workers. The role played by surface charge is evaluated. Methods are discussed for increasing the dielectric strength of insulators in vacuum. It is shown that a surface form of thermal breakdown can occur in a dielectric with a relatively high conductivity ( $\rho V$  less than or approximately equal to  $1E11$  ohm-cm). The characteristics of this breakdown are described. 25 Refs.  
Primary Keywords: Surface Flashover; Desorption Model; Dielectric Strength vs Insulator Length; Surface Charge; Thermal Breakdown  
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6438  
(PULSE GENERATORS)  
(Systems)  
A GENERATOR OF POWERFUL PULSES OF COMPLEX SHAPE  
A.A. Egorov, V.S. Panasyuk, L.I. Yudin and G.N. Ostapenko  
Institute Of Nuclear Physics, Academy of Sciences of the USSR, Novosibirsk, USSR  
Instruments And Experimental Techniques, No. 5, pp 1183-1186 (10/1966).  
Trans. From: Pribury i Tekhnika Eksperimenta 5, 156-159 (September-October 1966).  
A multicell thyratron generator of electric pulses of complex shape is described. Each section of the pulse can be independently controlled both in shape and amplitude. The design principle of such a generator is related to the task of obtaining millisecond pulses with a current amplitude of hundreds and thousands of amperes. The generator can be most profitably used for the production of large-amplitude current pulses of prescribed shape in various types of coils. In the majority of practical cases the generator makes it possible to reproduce a prescribed law of current variation. 2 Refs.  
Primary Keywords: Pulse Generation System; Variable Pulse Shape; Several Independent Sections; Millisecond Pulse Width; 100 kA Pulse Amplitude  
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6441  
(BREAKDOWN STUDIES; INSULATION, MATERIAL)  
(Liquid, Electrical; Liquid)  
AN INVESTIGATION OF THE ELECTRIC STRENGTH OF SOME LIQUID DIELECTRICS SUBJECT TO NANOSECOND VOLTAGE PULSES  
N.S. Rudenko and V.I. Isvatkov  
Tomsk Polytechnic Institute, Tomsk, USSR  
Soviet Physics-Technical Physics, Vol. 10, No. 10, pp 1417-1419 (10/1965).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 35, 1840-1843 (October 1965).  
Experimental tests of the electric strength of transformer oil, doubly-distilled water, and process water subject to nanosecond voltage pulses are described for sample thickness of 50, 100, 200, and 500 microns. The function  $E_{sub b} / \sqrt{t_{sub d}}$  is the electric field strength at breakdown, and  $t_{sub d}$  is the discharge time) can be explained under the assumption that the discharge is electronic. The results of the experiments yield the significant conclusion that water can be used as an insulator in high-voltage nanosecond devices; it is at least as good as transformer oil. 4 Refs.  
Primary Keywords: Liquid Insulation; Transformer Oil; Water; Thin Specimen Thickness; Breakdown Voltage Measurement; Comparison Of Results  
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6443  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
CERTAIN CHARACTERISTICS OF COLD CATHODES  
I.Z. Gleizer and V.V. Okulov  
Tomsk Polytechnic Institute, Tomsk, USSR  
Instruments And Experimental Techniques, Vol. 16, No. 4, pp 1214-1215 (04/1973).  
Trans. From: Pribury i Tekhnika Eksperimenta 4, 196-197 (July-August 1973).  
The procedure is described and results are presented for an investigation of the emission capacity and stability of the current from various cold cathodes. The service life of a multiemitter cathode with 2000 points and a working-surface diameter of 9 mm is determined. For a diode voltage of 130 kV and a pulse length of 15 nsec the average current in the cathode was 430 A for a relative measurement scatter of 4%. After 1f6 pulses the cathode characteristics did not change. 4 Refs.  
Primary Keywords: Field Emission Diode; Multiemitter Cathode; Life Test; 130 kV Operating Voltage; 430 A Current  
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6447  
(PARTICLE BEAMS, ION)  
(Generation)  
COLLECTIVE ACCELERATION OF IONS IN RELATIVISTIC ELECTRON BEAMS  
V.M. Bystritskiy, V.I. Podkatov, A.G. Sterligov, G.E. Remev and Yu.P. Ust'yanov  
Soviet Physics-Technical Physics, Vol. 2, No. 1, pp 30-32 (01/1976).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 2, 80-84 (January 1976).  
The model advanced of a two-dimensional stationary wall formed behind the anode of a nanosecond accelerator, as well as the results of recent investigations on ion acceleration in a relativistic electron beam (REB), indicate a threshold injection current  $I_{sub th}$  below which ion acceleration is not observed. To obtain additional data on the processes connected with acceleration of ions in REB, we have undertaken the investigations reported below. In the first group of experiments we establish the threshold values of the injection current for several diameters of the drift tubes (70 and 90 mm). As a rule, the ion pulses with amplitude above the electromagnetic noise level ( $\approx 10$  V) appear at values of the injection current larger than  $(1.3-1.4) I_{sub th}$ . In the second group of experiments we investigate the efficiency of ion acceleration as a function of the pressure of the gas filling the drift tube. 9 Refs.  
Primary Keywords: Collective Acceleration; Relativistic Electron Beam; Wide Incident Current Range; Threshold Current; Ion Beam Generation Efficiency  
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6448  
(PARTICLE BEAMS, ION)  
(Generation)  
COLLECTIVE ION ACCELERATION BY A HIGH-CURRENT RELATIVISTIC ELECTRON BEAM  
V.I. Kucherov  
Gorkii Polytechnic Institute, USSR  
Soviet Physics Technical Physics, Vol. 20, No. 6, pp 817-819 (12/1975).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 45, 1307-1310 (June 1975)  
Two-dimensional ion acceleration by the quasistatic field of a high-current relativistic beam moving with respect to the ion in a strong external magnetic field is studied analytically and numerically. The accelerating and focusing fields are found as functions of the beam current. The maximum energy and density of the accelerated ions are evaluated. 15 Refs.  
Primary Keywords: Collective Acceleration; External Magnetic Field; Beam Focusing; Theory; Analytical Calculation; Numerical Calculation; Energy Density Calculation  
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6449  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
COMPUTATION OF THE ELECTRIC FIELD AT MULTIPOINT CATHODES  
S.Ya. Belomyshev, S.P. Bugaev, V.P. Il'in, E.A. Litvinov and G.A. Mesyats  
Institute of Atmospheric Optics, Academy of Sciences of the USSR, Moscow, USSR  
Soviet Physics Journal, Vol. 18, No. 11, pp 1622-1623 (11/1975).  
Trans. From: Izvestiya Vysshikh Uchebnykh Zavedenii 18, 142-143 (November 1975)  
Ribbon electron beams with cross-sectional areas of  $1E2-1E4$  sq.cm. are now used in powerful electron ionization gas lasers. Such beams are produced using multipoint cold cathodes with explosive emission of electrons. The explosion of the tips of the points does not take place simultaneously with application of the voltage, but after some time called the delay time  $t_{sub}$ . To obtain a rectangular current pulse it is necessary that  $t_{sub}$  for most of the peaks should be comparable to the risetime of the voltage front  $t_{sub}/dV < t_{sub}/rV$ . 3 Refs.  
Primary Keywords: E-beam Generation; Multipoint Cathode; Rectangular Beam Pulse; Theory; Numerical Calculation; E-field Calculation; Analytical Formula  
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6451  
(PULSE GENERATORS)  
(Current)  
CURRENT PULSE GENERATOR  
B.F. Boyanov, A.V. Il'in, V.N. Pakin, A.P. Panov and G.I. Sil'vestrov  
Institute of Nuclear Physics, Academy of Sciences of the USSR, Novosibirsk, USSR  
Instruments and Experimental Techniques, No. 5, pp 1113-1117 (10/1968).  
Trans. From: Priroda i Tekhnika Eksperimenta 5, 96-100 (September-October 1968)  
A generator producing on an inductive load of approximately  $1E-7$  M current pulses with a flat peak with an amplitude of 200 kA at a pulse duration of 130 microseconds is described. Problems of commutation, design of pulse transformers, method of effective shaping of a flat peak, and stabilization of pulsed current within approximately  $\pm 0.1\%$  at a pulse repetition frequency of up to 5 Hz are examined. Experimental data are given on the use of TG11-2500/35 pulsed thyristors in nonstandard regimes of switching current pulses with a duration of 10-300 microseconds. 6 Refs.  
Primary Keywords: Constant-current Pulse; Inductive Load; 130 Microsecond Duration; Pulse Transformer; Good Repeatability; Rep-rated  
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6454  
(PULSE GENERATORS; SWITCHES, CLOSING)  
(Capacitive; Gas Gap; Optical)  
DRIVEN HIGH-VOLTAGE NANOSECOND PULSE GENERATOR TRIGGERED BY LASER RADIATION  
V.Yu. Petrun'kin, L.N. Pakhomov and P.A. Andreev  
Leningrad Polytechnical Institute, Leningrad, USSR  
Instruments and Experimental Techniques, Vol. 15, No. 2, pp 515-517 (04/1972).  
Trans. From: Priroda i Tekhnika Eksperimenta 2, 178-180 (March-April 1972)  
A high-voltage pulse generator (amplitude 30 kV) is described which is triggered by laser radiation. The generator is distinguished by a high sensitivity to the magnitude of the triggering light energy (not exceeding  $1E-3$  J), a short operate delay (approximately 40 nsec), and a pulse leading-edge duration  $< 1.5$  nsec. A generator construction is presented which allows the shaping of several synchronous high-voltage pulses obtained in various channels. 6 Refs.  
Primary Keywords: Nd-glass Laser; Steel Electrodes; Strip Line Configuration; Nanosecond Rise Time; Four-pulse Output  
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6456  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
ELECTRON ENERGY SPECTRUM IN HIGH-ENERGY NANOSECOND ACCELERATORS  
V.V. Kremnev, G.A. Mesyats and V.P. Reznikov  
Academy of Sciences of the USSR, Tomsk, USSR  
Soviet Physics-Technical Physics, Vol. 19, No. 10, pp 1362-1364 (04/1975).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 44, 2168-2173 (October 1974)  
The effects of matching the storage line to the diode, the switching time, and circuit inductance on the electron energy spectrum of an accelerator beam are considered. The spectrum is analyzed for a linear load, a diode with a field emission cathode, a diode with a thermionic cathode (three-halves law) and a diode with explosive electron emission. Relationships are obtained for the spectrum amplitude and half-width and for the maximum electron energy in the beam. Equations are derived for estimating the effects on the energy spectrum of the electron beam of movement of the plasma front in a diode with explosive emission and of retardation in a foil at the diode output. 4 Refs.  
Primary Keywords: E-beam Generation; Thermionic Emission Diode; Field Emission Diode; Storage Line; Impedance Matching; Switching Time; Inductance; Effect On Beam; Explosive Emission  
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6457  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
EMISSION OF ELECTRONS FROM THE PLASMA OF AN UNCOMPLETED DISCHARGE ALONG A DIELECTRIC IN A VACUUM  
S.P. Bugaev and G.A. Mesyats  
Academy of Sciences of the USSR, Tomsk, USSR  
Soviet Physics-Doklady, Vol. 16, No. 1, pp 41-43 (07/1971).  
Trans. From: Doklady Akademii Nauk SSSR 196, 324-326 (January 1971)  
The discharge current in an uncompleted discharge along a dielectric in a vacuum increases with increasing  $\epsilon_{sub}/D$  of the dielectric other conditions remaining equal. Therefore, we investigated the emission of electrons from the plasma of the discharge along a surface of barium titanate ( $BaTiO_3$  sub  $3/4$ ) having  $\epsilon_{sub}/D < 1500$ . A disk made of  $BaTiO_3$  sub  $3/4$  and having a thickness 0.2 mm was mounted in a vacuum chamber. A layer of silver was brazed onto one side of the disk while a needle made of tungsten having a point radius approximately 25 micron was pressed against the other side. The removal of electrons from the plasma was carried out by means of an extractor. Voltage pulses ranging from 0.4 to 4 kV having a leading edge  $t_{sub}/rV < 1$  nsec and length  $t_{sub}/rV < 2$  ns; 4; 8; 20; 50 nsec were applied between the electrodes. 8 Refs.  
Primary Keywords: E-beam Generation; Dielectric Surface Flashover; Effect Of Insulator Dielectric Constant; Threshold Voltage  
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6458  
(PARTICLE BEAMS, ION)  
(Generation)  
EXPERIMENTS ON ACCELERATION OF DEUTERONS AND PROTONS IN AN ELECTRON BEAM PASSING THROUGH A GAS  
A.A. Kolomenskii, V.M. Likhachev, I.V. Sinil'shchikova, O.A. Smit and V.N. Ivanov  
P.N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow, USSR  
Soviet Physics JETP, Vol. 41, No. 1, pp 26-27 (01/1975).  
Trans. From: Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki 68, 51-54 (January 1975)  
We have carried out experiments on acceleration of deuterons and protons on passage of a high-current electron beam through a low pressure gas at  $p_{sub}/D < 0.37$  for an electron energy of 700 keV the maximum energy of the accelerated deuterons and protons exceeds 2 MeV. The total number of accelerated particles in a pulse reaches approximately  $1E12$ . 10 Refs.  
Primary Keywords: Collective Acceleration; High Beam Energy; Low Beam Current; Several Diagnostics Techniques  
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6461  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
HIGH-CURRENT CAVITY ELECTRON ACCELERATOR  
D.V. Iremashvili, M.I. Leont'ev and A.A. Pivovarov  
Sukhumi Physico-technical Institute, Sukhumi, USSR  
Instruments and Experimental Techniques, No. 2, pp 261-266 (04/1967).  
Trans. From: Priroda i Tekhnika Eksperimenta 2, 35-40 (March-April 1967)  
The operating principle of a pulsed high-current electron accelerator with the following parameters is described: accelerating potential 1-1.3 MV, electron current up to  $1E3$  A in a pulse with a duration of approximately 70 nsec. The frequency of the operating cycles is 1-5 Hz. The designs of the cavity resonator and spark source are given, along with their basic characteristics. 5 Refs.  
Primary Keywords: Resonant Cavity Accelerator; Design Considerations; 1 MV Accelerating Potential; 1 kA Current; Spark Source; Rep-rated  
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6465  
(BREAKDOWN STUDIES)  
(Vacuum; Electrical)  
INVESTIGATION OF THE TIME CHARACTERISTICS OF THE TRANSITION OF FIELD EMISSION TO A VACUUM ARC  
G.K. Kartsev, G.A. Mesyats, D.I. Proskurovskii, V.P. Rotshtein and G.N. Furze  
A.A. Zhdanov Leningrad State University, Leningrad, USSR  
Soviet Physics-Doklady, Vol. 15, No. 4, pp 475-477 (11/1970).  
Trans. From: Doklady Akademii Nauk SSSR 192, 308-312 (May 1970)  
It was of interest to investigate the explosion of catheters at much higher field current densities than previously done and to investigate thoroughly the change in current from the start of explosion to complete occupation of the gap by plasma. An increase in current density leads to a reduction of the time before explosion and, hence, to obtain maximum current densities ( $> 1E9$  A/sq.cm.) we used voltage pulses with a rise time  $t_{sub}/rV$  approximately  $1E-9$  sec and a length  $t_{sub}/rV$  of 5 nsec to 4 microseconds. The circuit of the pulse generator was described previously. The current flowing through the vacuum gap was measured at different stages with a resolution of not more than  $1E-9$  sec. The sensitivity of current measurement was  $7E-2$  A. 15 Refs.  
Primary Keywords: Vacuum Breakdown; Arc Transition; Single Crystal Tungsten Cathode; Cathode Explosion; Comparison With Exploding Wires  
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6467  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
MULTIELEMENT ACCELERATORS BASED ON RADIAL LINES  
A.I. Pivovarov, V.S. Bosomykin, G.D. Kulashov, A.I. Gerasimov, V.A. Tarakanin and A.P. Klement'ev  
Soviet Physics-Doklady, Vol. 20, No. 6, pp 441-443 (06/1975).  
Trans. From: Doklady Akademii Nauk SSSR 222, 817-820 (June 1975)  
For several years the authors have been carrying out investigations of high-current pulsed electron accelerators based on radial lines, which allow the realization of cylindrical accumulation of electromagnetic energy. The maximum energy flux density is determined by the limiting values of the electric and magnetic fields which are attained in such devices. In many important practical cases the pulse length and the magnitude of the working voltage are stipulated with allowance for the dielectric strength of the dielectrics which are used, these conditions uniquely determine the upper limit of the energy-source power. One of the methods for achieving a further increase in the power of high-current acceleration and other installations in which a high density of the electromagnetic energy flux is required involves the use of a large number of radial lines, which are connected in series, in parallel, or in a mixed manner, depending on the required amplitudes of the current and the voltage. 5 Refs.  
Primary Keywords: Radial Line; Accelerator; Insulation Considerations; Line Loss  
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6469  
(BREAKDOWN STUDIES)  
(Gas, E-beam)  
NONINDEPENDENT PULSED ATMOSPHERIC PRESSURE DISCHARGE SUSTAINED BY A HIGH-ENERGY ELECTRON BEAM LASTING 100 MICROSECONDS  
Yu.I. Vyshkov, S.A. Genkin, Yu.D. Korolev, G.A. Masyshev, V.G. Rabotkin and A.G. Filonov  
Institute Of Atmospheric Optics, Academy of Sciences of the USSR, Moscow, USSR  
Soviet Physics Journal, Vol. 18, No. 11, pp 1618-1619 (11/1975).  
Trans. From: Izvestiya Vsesoyuznogo Nauchnoykh Zavedaniy, Fizika 18, 139-140 (November 1975)  
The use of a high-energy electron beam for ionizing a gas is an effective method of exciting high-pressure space discharges. The use of comparatively weak beams substantially increases the duration of such discharges and allows us to obtain stationary combustion conditions for weak electric fields that obviously insure that the discharge will be nonindependent. However, in this case the selection of conditions for maximal energy influx into the space discharge involves theoretical questions. The problem of how to increase the input energy while maintaining the stability of the discharge will be considered in the present work. An instrument similar to that described previously was used to excite an atmospheric pressure discharge in CO/sub 2/N/sub 2 mixtures. The duration of the beam current was 1E-4 sec. Electrons were injected through the gas discharge gap cathode over an area of 6x6 cm. Inter-electron distance d was 6 cm. The energy scattered in the gas was determined from oscillograms as well as from readings of an electrostatic kilovolt meter, which was connected in parallel to the gap and a cell-charged capacitance. The capacitance was selected as sufficiently high in order to insure that the electric field would be constant during the pulse. 7 Refs.  
Primary Keywords: Atmospheric Pressure Discharge; High-energy Electron Beam; E-beam Excited Discharge; 1E-4 sec Beam Current Duration; Nonindependent Discharge; Discharge Stability; Nonuniform Ionization  
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6476  
(POWER TRANSMISSION)  
(Contacts)  
REMOTELY CONTROLLED CONTACTS CARRYING MEGAAMPERE CURRENTS  
G.S. Villeval'd, V.N. Karasyuk and G.I. Sil'vestrov  
Nuclear Physics Institute, Academy of Sciences of the USSR, Novosibirsk, USSR  
Instruments And Experimental Techniques, Vol. 21, No. 4, pp 980-982 (08/1978).  
Trans. From: Pribery i Tekhnika Eksperimenta 4, 128-130 (July-August 1978)  
The construction and the manufacturing technology is described of annular hydraulic contact clamps. Results are presented of lifetime tests at a current of approximately 1 MA made on clamps with diameters of 80-170 mm. 3 Refs.  
Primary Keywords: High Current Contact; Hydraulic Closing; 1 MA Current Capability; High Reliability  
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6477  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
REPRODUCIBILITY OF DELAY TIME FOR BREAKDOWN OF HIGH-PRESSURE TRIGGERED SPARK GAPS  
G.S. Korshunov, M.S. Rudenko and V.I. Tsavetkov  
Soviet Physics-Technical Physics, Vol. 14, No. 8, pp 1074-1078 (02/1978).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 59, 1430-1436 (August 1969)  
Results are given of studies of breakdown delay time of high-pressure (p=1 to 15 atm) triggered spark gaps in the nanosecond range with positive and negative pulses, both with and without irradiation of the spark gap. The tests were made with pulse amplitudes of 100 to 600 kV with 2 nsec front. Two variants of irradiation were used. Prior irradiation did not improve stability. High stability is obtained by irradiating the gap at the time the trigger pulse is applied (t/sub tr/±7 ±0.5 nsec, t/sub tr/±29 ±0.3 nsec). It is shown that cathode irradiation plays the major part, mainly by causing electron emission from the cathode. Photoionization of gas in the discharge gap is not important. Recommendations are given concerning the construction of high-stability trigger gaps operating at hundreds of kilovolts in the nanosecond time range. 11 Refs.  
Primary Keywords: Spark Gap; Delay Measurement; 1-15 atm Pressure Range; Bipolar Trigger Pulses; Gap Irradiation; Cathode Effects  
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6479  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
SELF-ACCELERATION OF AN ELECTRON BEAM IN A GYROTROPIC MEDIUM  
M.N. Masonov and A.M. Shenderovich  
Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Kharkov, USSR  
Soviet Physics-Technical Physics, Vol. 20, No. 7, pp 932-935 (07/1975).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 45, 1476-1481 (July 1975)  
In a theoretical study of the excitation of electromagnetic fields by an electron beam passing through a longitudinally magnetized ferrite, calculations are carried out for two cases: that of an infinite gyrotropic medium and that of a waveguide partially filled with a ferrite. After the front of the beam pulse passes, a longitudinal electric field arises as a result of the precession of the magnetic moment of the ferrite. This electric field accelerates part of the beam. 4 Refs.  
Primary Keywords: E-beam Acceleration; Gyrotropic Medium; Ferrite-filled Waveguide; Magnetic Moment Precession  
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6480  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
SPARK CURRENT AND VOLTAGE IN NANOSECOND BREAKDOWN OF A GAS GAP  
G.A. Masyshev, V.V. Kravtsov, G.S. Korshunov and Yu.B. Yankelevich  
Tomsk Polytechnic Institute, Tomsk, USSR  
Soviet Physics-Technical Physics, Vol. 14, No. 1, pp 49-53 (07/1969).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 39, 75-81 (January 1969)  
Current and voltage across a spark gap in a pulsed breakdown in air were calculated as time-dependent variables, with the resistance of the discharge circuit and the capacitance of the spark gap taken into account. The current in the spark gap was assumed to be controlled by avalanche electrons. Excellent agreement between theoretical and experimental curves was obtained at spark gap overvoltage levels. A simple equation is proposed for calculating the maximum slope of voltage decay across the spark gap, ignoring gap capacitance. The conditions under which this equation is valid are specified. The effect of increased rate of gap voltage decay with increased interelectrode capacitance is demonstrated. 11 Refs.  
Primary Keywords: Gas Spark Gap; Air Gap; Current Measurement; Voltage Measurement; Experiment; Theory; Good Agreement; Analytical Formula  
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6485  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
THE EMISSION OF OXIDE CATHODES IN A STRONG LONGITUDINAL MAGNETIC FIELD  
S. Rutshkevich  
Radio Engineering And Electronics Physics, Vol. 16, No. 4, pp 710-712 (04/1971).  
Trans. From: Radiotekhnika i Elektronika 16, 648-650 (April 1971)  
The authors theorize that the discrepancy between experimental and theoretical values of the electron emission of an oxide cathode is due to the porosity of the oxide coating. This porosity of the coating allows electrons to be emitted from the base of oxide particles which increases the total emitting surface. To test this theory, the emission of an oxide cathode is measured with and without a longitudinal magnetic field. Emission is found to be reduced significantly for large currents, which supports the hypothesis that oxide porosity effects are important. 5 Refs.  
Primary Keywords: E-beam Generation; Thermionic Cathode; Oxide Cathode; Longitudinal Magnetic Field; Reduced Emission; Area Effects  
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6489  
(PULSE GENERATORS)  
(Pulse Forming Lines)  
IMPROVEMENTS ON TRANSMISSION-LINE PULSERS  
R.E. Dollinger, C.P. Scheffler and D.A. Moll  
State University of New York at Buffalo, Buffalo, NY 14226  
IEEE Transactions On Electron Devices, Vol. ED-26, No. 10 pp 1551-1553 (10/1979).  
A series of pulsers operating up to 100 kW with efficiencies up to 80 percent have been built. The voltage levels, rise times, durations, and repetition rates have been investigated for pulsers operating into different loads. The difficulties of mechanical and solid-state switching (e.g., contact erosion, sticking, and bouncing contacts), have been eliminated by using a stream of mercury droplets to bridge the gap between two switch electrodes in order to discharge a transmission line into a load or by discharging charged mercury droplets into the load. 9 Refs.  
Primary Keywords: Pulse Generator; Fast Rise; Low Impedance; Rep-rated  
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6491  
(PULSE GENERATORS)  
(Trigger)  
A PROGRAMMING GENERATOR PRODUCING POWERFUL NANOSECOND PULSES  
V.P. Krylov, A.N. Meshkov, V.N. Smirnov and V.I. Shishko  
Gorkii Polytechnic Institute, USSR  
Instruments And Experimental Techniques, Vol. 18, No. 6, pp 1788-1789 (12/1975).  
Trans. From: Pribery i Tekhnika Eksperimenta 6, 106-107 (November-December 1975)  
A controlled paired-pulse generator is described which uses the shaping of electromagnetic shock waves in a transmission line containing ferrite. The external program stipulates the time interval between the pulse edges (10, 50, or 250 nsec) which determines the duration of the electron beam in a high-current linear electron accelerator to which the generator pulses having an amplitude of 4 kV are supplied. The generator ensures a rise and decay time of the electron concentration in the beam amounting to 2 nsec, and a time instability of the beam relative to the starting pulse which does not exceed 1 nsec. 2 Refs.  
Primary Keywords: Pulse Generator; Paired-pulse Generator; Ferrite Loaded Line; Electromagnetic Shock Wave; 2 ns Rise And Fall; 40-ohm Impedance  
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6493  
(SWITCHES, OPENING)  
(Hall Effect)  
APPLICATION OF THE HALL EFFECT TO THE SWITCHING OF INDUCTIVE CIRCUITS  
E.K. Inall, A.E. Robson and P.J. Turchi  
Naval Research Lab, Washington, DC 20375  
The Review Of Scientific Instruments, Vol. 48, No. 4, pp 462-463 (04/1977).  
Experiments are described in which the application of a pulsed magnetic field to a Corbino disk of indium antimonide causes an increase in resistance of about 2 orders of magnitude in a time of 5 microseconds. The use of this element as a switch for the transfer of energy from an inductive energy store is discussed. 9 Refs.  
Primary Keywords: Hall Effect Switch; Pulsed Magnetic Field; Indium Antimonide; Corbino Disk; 100-fold Increase In Resistance; 5 Microsecond Rise Time  
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1979)  
An experimental arrangement is described for studying field emission in the avalanche mode at a pulse duration of up to 0.7 nsec. The Fowler-Nordheim characteristics are given along with oscillograms of the transition of field emission to the explosion emission mode. 5 Refs.

Primary Keywords: Field Emission; High Current Density; Emitter Melting; Vacuum Breakdown; Peak Current vs Pulse Width

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503  
(PARTICLE BEAMS, ELECTRON)  
ELECTRON ACCELERATION IN A TWO-CONDUCTOR STRUCTURE  
(Generation)  
E. G. Bessonov, A. A. Gerasimov, and A. V. Kuvshinov  
P. N. Lebedev Physics Institute, Academy of Sciences of the USSR,  
Moscow, USSR  
Soviet Technical Physics Letters, Vol. 4, No. 4, pp 188-189 (04/1978).  
Trans. From: *Fizicheskii Zhurnal Tekhnicheskoi Fiziki* 4, 467-470 (April 26,  
1978).

6506  
(BREAKDOWN STUDIES; PARTICLE BEAMS, ION)  
(Vacuum, Electrical; Generation)  
EMISSION PROPERTIES OF THE PLASMA OF VACUUM SPARKS. I. ION BEAMS  
K.V. Suladze and A.A. Plyuto  
Soviet Physics-Technical Physics, Vol. 10, No. 7, pp 1006-1013  
(01/1966).  
Trans. from: Zhurnal Tekhnicheskoi Fiziki 35, 1298-1307 (July 1965)  
The emission properties of the plasma of vacuum sparks in  
producing heavy-current beams of  $H^+sup +/-$  and  $D^+sup +/-$  with a spark  
source were studied. With large emitting surface (5 to 7 sq.cm.)  
ion-current densities of 5 to 15 A/sq.cm. and total ion currents of  
50 to 100 A in a 10-6 sec pulse are achieved. The ion current to the  
Faraday cylinder is 40% of the total current. Compensation of the  
beam by secondary electrons has been observed. Mass-spectroscopic  
investigations show that the  $H^+sup +/-$  and  $D^+sup +/-$  ions amount to 80%  
of the total beam current on the average. 29 Refs.  
Primary Keywords: Ion Beam Generation; Vacuum Breakdown; 100 A Ion  
Beam; Hydrogen Ion Beam; Deuterium Ion Beam  
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5510  
(SWITCHES, CLOSING; SWITCHES, CLOSING)  
(Gas Gaps, Electrical; Thyratrons)  
FAST HIGH-VOLTAGE HIGH-CURRENT SWITCH: THYRATRON-SPARK GAP HYBRID  
R.B. Gibson  
Massachusetts Institute of Technology, Cambridge, MA  
The Review Of Scientific Instruments, Vol. 50, No. 11, pp 1489-1490  
(11/1975)  
A high-voltage high-current switch using a hydrogen thyatron in series with a two-element spark gap is described. The hybrid switch triggers like a thyatron, turns off like a spark gap, and holds off twice the potential of either element alone. 0 Refs.  
Primary keywords: Thyatron; Self-trigger Spark Gap; Series Combination; Thyatron Triggering; Spark Gap Recovery  
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6528 NANOSECOND PULSERS FOR MM WAVE TUBES  
J. Stover, N. Komatsu and A. Niato  
ECOM, Fort Monmouth, NJ 07703  
Interim rept. no. 2, Feb-Mar 79 No. HAC-FR-79-14-353, 18p (02/1980).  
Availability: AD-0080 950/\$  
NTIS  
The AVG avalanche transistor has been selected as the switching element for the nanosecond pulsers. Still open for consideration is a high voltage (400V) VHS FET that will be available shortly for evaluation of the device operating in avalanche mode.  
Primary Keywords: Pulse Generators; Electronic Switches; Metal Oxide Semiconductors; Field Effect Transistors; Switching Circuits; Bipolar Transistors; Millimeter Waves; Junction Transistors; Power Supplies; Avalanche Effect (Electronics); Electron Tubes; Electric Wire  
Secondary Keywords: Avalanche Transistors; NTISDDDA; NTISSDDA

5535  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
SELF-ACCELERATION OF A CHOPPED ELECTRON BEAM IN A FERRITE-FILLED  
WAVEGUIDE  
N. M. Maslov and A. M. Shenderovich  
Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR,  
Khar'kov, USSR  
Soviet Physics-Technical Physics, Vol. 21, No. 9, pp 1090-1093  
(1976)  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 46, 1873-1878 (September  
1976)  
The shock excitation of the precession of the magnetic moment of  
ferrite by the trailing edge of an intense electron beam that moves  
along the axis of a waveguide filled with ferrite rings magnetized  
to saturation, is analyzed. Solution of Maxwell's equations and the  
Landau-Lifshitz equation for the remagnetization of the ferrite  
yields an electric field which accelerates the particles at the  
trailing edge of the beam. Axially magnetized and azimuthally  
magnetized ferrites are considered. (S. Refs.)  
Primary Keywords: E-beam Generation; Self-acceleration; Ferrite Rings;  
Saturated Magnetization; Remagnetization; E-field  
Generation  
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6542  
(SWITCHES, OPENING)  
(Gas Gases, Crossed-field)  
THE GAMITRON-A HIGH POWER CROSSED-FIELD SWITCH TUBE FOR HVDC  
INTERRUPTION

M.A. Lutz and G.A. Hofmann  
Hughes Research Labs., Malibu, CA 90265  
IEEE Transactions On Plasma Science, Vol. PS-2, No. 1, pp 11-18  
(03/1974).

A high power crossed-field discharge device has been developed for use as a high voltage direct current interrupter. This device operates at low pressure (0.05 Torr), conducting current at a fixed voltage (approximately 500 V) only in the presence of a weak magnetic field (approximately 100 G) which is substantially perpendicular to the electric field between the electrodes. When the magnetic field is removed, ionization ceases and current interruption results. Physical phenomena occurring in this device have been investigated, including the glow-to-arc transition, gas cleanup, and high voltage breakdown. Based on the results of these investigations, switch tubes have been developed and successfully tested at the 2 kA, 100 kV level, with recovery rates in excess of 2 kV/microseconds. The availability of such devices will make possible many applications including HVDC circuit breakers, AC current limiters, and practical inductive energy storage. 30 Refs.

Primary Keywords: Crossed-field Switch; Gamitron; Opening Switch; External Magnetic Field; Field Removal Opening; Glow-to-arc Transition; Gas Cleanup; 2 kV/microsecond Opening Rate

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6543  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
THE GROWTH RATE OF THE POWER IN A PULSED HIGH-CURRENT BEAM OF  
ACCELERATED ELECTRONS

I.N. Slivkov  
All-Union Institute, Moscow, USSR  
Instruments And Experimental Techniques, Vol. 18, No. 2, pp 352-354  
(05/1975)  
Trans. From: Priroda i Tekhnika Eksperimenta 2, 28-29 (March-April 1975)

It is shown that the growth rate of the power of a beam of electrons obtained in pulsed high-current accelerators is limited by the wave impedance of the circuit sections, and primarily by the wave impedance of the diode. The indicated limitation may be overcome by means of a stepwise increase in voltage. A method for effecting such an increase is proposed. 4 Refs.

Primary Keywords: E-beam Generation; Power Rise; Circuit Impedance; Diode Impedance; Voltage Pulse Shaping

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6546  
(POWER CONDITIONING)  
(Saturable Reactors)  
THE USE OF FERRITES FOR THE GENERATION OF POWERFUL HIGH-VOLTAGE PULSES  
OF NANOSECOND DURATION

S.I. Vanyukov, M.P. Andreyev and V.A. Serabryakov  
State Optical Institute, USSR  
Instruments And Experimental Techniques, No. 3, pp 502-505 (06/1962).

When a conductor loaded with ferrite toroids is connected into the circuit of a high-current spark discharge it is observed that high-voltage nanosecond impulses arise across the loaded segment with powers of the order of 10<sup>5</sup> W. Data are presented concerning the influence of the discharge parameters on the amplitude, duration and repetition frequency of these impulses. 4 Refs.

Primary Keywords: Pulse Sharpening; Ferrite Loaded Transmission Line; Switch Parameters; Effect On Pulse Shape

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6548  
(PARTICLE BEAMS, ELECTRON)  
(General)  
TRANSFORMER TYPE ACCELERATORS FOR INTENSE ELECTRON BEAMS

E.A. Abramyan  
Institute Of Nuclear Physics, Academy of Sciences of the USSR,  
Novosibirsk, USSR  
IEEE Transactions On Nuclear Science, Vol. NS-18, No. 3, pp 447-455  
(06/1971)

The principles and designs of transformer accelerators (TA) generating intense beams of charged particles over energy ranges 0.5-5 MeV are described. Pulse electron accelerators with pulse lengths of 1E-8 to 1E-5 sec are investigated (some of them have a repetition rate of several hundred cps) as well as one-phase and three-phase 50-cps transformers. The most models' power efficiency is in the range of 60-95%, the averaged beam power comes up to or exceeds 10 kW and is in excess of 150 kW for one of the last models. The design of a 5 MeV single-pulse TA with peak current of 30 kA at pulse length of 60 nsec and of 1.2 MeV proton TA with average beam power of 10 kW are described. The features of main components of high voltage transformers and of intense current acceleration tubes are discussed. 18 Refs.

Primary Keywords: Transformer Accelerator; High Efficiency; 5 MeV Beam Energy; 10 kA Current; Design Considerations

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6549  
(POWER CONDITIONING)  
(Pulse Transformers)  
USING A CABLE PULSE TRANSFORMER IN THE POWER SYSTEM OF A GAS LASER

A.S. Maslov, A.A. Ishev, V.M. Kaslin and G.G. Petrash  
Physics Institute, Academy of Sciences of the USSR, Moscow, USSR  
Instruments And Experimental Techniques, No. 4, pp 934-935 (08/1967).  
Trans. From: Priroda i Tekhnika Eksperimenta 4, 232-233 (July-August 1967)

Pulsed gas lasers have recently gained wide use and are being intensively studied. Certain characteristics, for example, the possibility of generation in the widest spectral interval from ultraviolet to far infrared make them very promising for a number of practical problems. Up to the present time, generation in the ultraviolet region has been obtained only with gas lasers in the pulsed mode. The power attained with generators of this type reaches 200 kW. The discharge of a capacitor through a spark gap or a thyatron is usually used to excite pulsed gas lasers. Since the working voltage reach 50 kV, and in some cases higher voltage is desired, serious power difficulties arise. A power supply for a pulsed gas laser that allows the required characteristics to be obtained by comparatively simple means is described below. 5 Refs.

Primary Keywords: Coaxial Cable Pulse Transformer; High Power; Low Pulse Distortion; High Efficiency

Secondary Keywords: Gas Laser Pumping

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6552  
(PARTICLE BEAMS, ELECTRON; ENERGY STORAGE, INDUCTIVE)  
(Generation; Systems)  
A MULTIELECTRODE ELECTRON-OPTIC SYSTEM WITH AN INDUCTIVE STORAGE DEVICE  
FOR A HIGH-CURRENT ACCELERATOR

A.A. Kozlov, A.E. Maslov, G.I. Prakhova and I.N. Slivkov  
Prakhova, And I.N. Slivkov Scientific-Research Institute Of  
Opticophysical Measurements, Moscow, USSR  
Instruments And Experimental Techniques, Vol. 18, No. 3, pp 685-687  
(06/1975)

Trans. From: Priroda i Tekhnika Eksperimenta 3, 25-27 (May-June 1975)  
The circuit of an accelerator with an inductive energy-storage device and a multielectrode electron-optic system is described. The results of studying the characteristics of such a system with models are presented. The possibility of creating an electron-optic system having the properties required for an accelerator is demonstrated. 2 Refs.

Primary Keywords: E-beam Generation; Inductive Energy Store; Electron-optic System; Design Considerations

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6562  
(SWITCHES, CLOSING)  
(Liquid Metal)  
PULSE MODULATOR BEHAVIOR OF THE LIQUID METAL PLASMA VALVE (LMPV)

W. Wright Jr (1) and J.R. Bayless (2)  
(1) ECOM, Fort Monmouth, NJ 07703  
(2) Hughes Research Labs., Malibu, CA 90265

1978 IEEE Thirteenth Modulator Symposium, pp 83-87 (06/1978).  
The LMPV is a mercury-cathode, triggered, closing switch which employs a small area mercury pool and a cooled (-30 Deg.C.) condensing surface to maintain the conditions for vacuum arc operation. These conditions result in high-voltage capability, fast recovery and high current operation with negligible cathode wear. Therefore, the LMPV was considered to have potential as a high average power closing switch for modulator applications. An LMPV closing switch (LMPVCS) was built at Hughes Research Laboratories and evaluated at ERADCOM at voltages up to 150 kV, currents up to 8 kA peak and 7.5 A average, pulse lengths up to 50 microseconds, and repetition rates up to 250 Hz. The device failed as a result of excessive anode dissipation caused by a long anode fall time on the order of 5 microseconds. Subsequent experimentation has indicated that the fall time is reduced at increased mercury vapor pressures, however, experiments are required to define the relation between the fall time and voltage hold-off capability. 3 Refs.

Primary Keywords: Closing Switch; Vacuum Gap; High Voltage; Fast Recovery; Rep-rated

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6571  
CONSTANT CURRENT CHARGING CIRCUITS FOR HIGH ENERGY MODULATORS

J.L. Carter  
Department of the Army, Washington, DC  
Patent No. PAT-APPL-759 684, B (06/1978).  
Availability: AD-D005 499/95T

NTIS  
A means is described for achieving square wave charging of pulse forming networks in line type pulsed which include parallel pulse forming networks with charging inductors connected between the PFNs. The cumulative value of the distributed inductance of the charging inductors is chosen so that when combined with the total capacitance of the PFNs, the charging network pulsedwidth equals the interpulse period. (Author)

Primary Keywords: Patents; Circuits; Pulse Modulation; Pulse Generators; Square Waves; Inductors; Capacitors; High Energy

Secondary Keywords: PAT-CL-328-65; NTISGPA  
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6582  
BREAKDOWN STUDIES: DIAGNOSTICS AND INSTRUMENTATION)  
(Gas, Electrical; Miscellaneous)  
SPECTROGRAPHIC ERRORS IN PULSED DISCHARGES

W.H. Wright Jr.  
ECOM, Fort Monmouth, NJ 07703  
The Review Of Scientific Instruments, Vol. 41, No. 2, pp 265-269  
(02/1970)

The method of electronically processing the detector signal can be critical when making spectrographic measurements on a pulsed discharge. The output of the commonly used synchronous detector is dependent on both signal amplitude and signal pulse shape, and, when the shape of the radiated light pulse varies with wavelength, serious errors can be introduced. Two disparate spectrograms are shown that were taken from the same light source, differing only in signal processing, and the reasons for the discrepancies are explained. When taking spectrograms of pulsed light sources where afterglow effects may result in a variable pulse shape, it is recommended that the synchronous detector not be used; if the resultant spectrogram is to be power vs wavelength, then some form of signal sampling should be used instead. A measurement technique using a sampling oscilloscope for signal processing is described. A curve is included that predicts the magnitude of error introduced when using the synchronous detector to process a rectangular pulse exponential decay signal. The error discussed does not exist when studying a mechanically chopped continuous light source since the pulse shape then depends only on the chopper and is invariant. 6 Refs.

Primary Keywords: Pulsed Breakdown; Spectrographic Diagnostic; Synchronous Detector; Effect Of Afterglow

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6583  
(SWITCHES, CLOSING; SWITCHES, CLOSING; ENERGY STORAGE)  
(Gas Gaps, Self; Gas Gaps, Systems; System Protection)  
THE 'HOURGLASS' ENERGY DIVERTER  
S. Schneider and A.J. Buffa  
ECOM, Fort Monmouth, NJ 07703  
IEEE Transactions On Electron Devices, Vol. ED-14, No. 8, pp 433-438  
(08/1967)

A new design for a series spark-gap array for energy diverter usage has been developed. The electrical circuit of this array differs from previously reported energy diverter designs in two respects. First, the capacitors from each electrode to ground are eliminated, and second, the interelectrode capacitances of the gaps are not all equal. By varying the interelectrode capacitances of each gap in accordance with predetermined requirements, it was possible to study several triggering modes. In particular, two triggering modes were investigated: a 'constant overvoltage' mode and an 'increasing overvoltage' mode. 7 Refs.  
Primary Keywords: Spark Gap Array; Series Operation; Non-constant Interelectrode Capacitance; Several Triggering Modes  
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6584  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Current)  
RECTANGULAR BEAM FARADAY CUP

J. Shannon  
Maxwell Labs Inc, San Diego, CA 92123  
1976 IEEE Pulsed Power Conference Proceedings, Paper IE-5 (11/1976).  
A Faraday Cup was developed for calibrating current sensors in generators producing rectangular electron beams. The current is measured with 24 re-entrant cavities of known area arranged to average the beam current. Design criteria are discussed, including the error due to spatial variations of the beam, the high frequency response, and late time effects due to resistive losses in the walls of the cavity. A criteria for optimizing the low frequency response of the cavity using the finite time constant of the passive integrator is given. 0 Refs.  
Primary Keywords: Faraday Cup; E-beam; Current Sensor; Design Considerations  
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6585  
(ENERGY CONVERSION, ELECTRICAL)  
(Power Supplies)  
INTERIM REPORT ON DEVELOPMENT OF HIGH POWER, SHORT DUTY TRANSFORMER/RECTIFIER UNITS

R.I. McNeill Jr. and R.L. Hauman  
Thermal Technology Lab, Inc., Buffalo, NY  
1976 IEEE Pulsed Power Conference Proceedings, Paper IIE-2 (11/1976).  
This report describes the development of transformer/rectifier (T/R) units capable of delivering high power for relatively short periods of time. The primary objective of the program was to develop lightweight and compact T/R-units to minimize the size and weight of the final system consistent with other specified requirements. A specific weight of 0.25-0.3 lbs./kva. was achieved for the final 6 MW T/R-system, including all associated external cooling apparatus. The results of parametric optimization and engineering design studies leading to the selection and final development of two (2) forced oil cooled 3 MW T/R-units are presented. Included in the results is a discussion of the advantages and disadvantages of different cooling techniques including vaporization, adiabatic, and forced liquid cooling and a detailed thermal analysis of the final T/R-system design. The development and use of computer aided transformer design optimization procedures is also discussed. 0 Refs.  
Primary Keywords: Power Supply; Burst Mode; High Power; Light Weight  
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6587  
(BREAKDOWN STUDIES)  
(Liquid, Electrical)  
BROADENING OF A HIGH-INTENSITY SPARK CHANNEL IN A LIQUID  
V.S. Konev and Yu.V. Shvartsov  
Soviet Physics Doklady, Vol. 4, No. 6, pp 1313-1316 (06/1960).  
Trans. From: Doklady Akademii Nauk SSSR 129, 1273-1276 (November-December 1959)

In the present paper, the results of an investigation on the initial stages of the broadening of a spark channel in a liquid (the first period of current flow) are described. A discharge originated in water along the axis of a cylindrical transparent container (chamber) with a diameter of 40-70 mm, a height of 50 mm, between brass needle-shaped electrodes placed at an interval of 12-15 mm. A current loop with a capacitance of 2.7-280 microfarad and a potential  $U_{max}$  of 20-40 kV, was discharged through a circuit with an inductance  $L = 7E-6$  henries. The loop was closed with the burning away of air or detonation-type dischargers, which received a synchronized pulse from a photorecorder. 5 Refs.  
Primary Keywords: Water Breakdown; Initial Current; Voltage Measurement; Current Measurement; Photographic Measurement; 12 kA Current; Thermal Considerations; Temperature Variation  
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6590  
(INSULATION, MATERIAL)  
(Liquid)  
DIELECTRIC STRENGTH OF PAPER-OIL INSULATION ACTED ON BY DC VOLTAGE  
V.G. Rutkevich, A.K. Lohmann and V.M. Ponomarev  
Soviet Electrical Engineering, Vol. 49, No. 4, pp 47-52 (04/1978).  
Trans. From: Elektrotehnika 49, 28-32 (1978)

The authors study the resistivity and dielectric strength of oil-impregnated paper sheet and tape insulation in this paper. Field strength, temperature, and moisture content were all varied in a controlled experiment to determine their effect on the properties of the insulation in question. 8 Refs.  
Primary Keywords: Oil-impregnated Paper Insulation; Resistivity Measurement; Dielectric Strength Measurement; DC Field; Field Strength Variation; Moisture Variation; Temperature Variation  
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6595  
(PARTICLE BEAMS)  
(Generation)  
FORMATION OF INTENSE CHARGED PARTICLE BEAMS IN A CURRENT-CARRYING PLASMA  
K.V. Suladze  
Sukhumi Physiotekhnical Institute, Sukhumi, USSR  
JETP Letters, Vol. 15, No. 11, pp 459-462 (06/1972).  
Trans. From: ZhETF Pis'ma V Redaktsiyu 15, 648-652 (June 1972)

This paper reports an investigation of intense charged-particle beams occurring in a current-carrying plasma as a result of formation of a 'break' on which the entire potential difference is concentrated. A strong electric field inside a plasma accelerates the charged particles and the entire discharge current is carried by the beams of electrons and ions. The limiting accelerated-particle current  $J_{lim}$  is determined by the plasma concentration and can reach large values. 10 Refs.  
Primary Keywords: Particle Beam Generation; Plasma Dynamics; Potential Break; Turbulent Plasma Layer; E-beam; Ion Beam  
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6598  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
HIGH-CURRENT PULSED ELECTRON ACCELERATOR

E.A. Abramyan and S.B. Vesserman  
Soviet Atomic Energy, Vol. 23, No. 1, pp 709-711 (07/1967).  
Trans. From: Atomnaya Energiya 23, 44-45 (July 1967)  
The acceleration of electron beams with intensities of hundreds of amperes of energies of several Mev with pulses lasting  $1E-9 - 1E-5$  sec can be carried out very effectively with apparatuses in which a Tesla transformer is used as the high-voltage source. 0 Refs.  
Primary Keywords: Electron Accelerator;  $1E-9 - 1E-5$  Sec Pulse Length; Tesla Transformer; High Pulse Powers; High Average Beam Powers; High Efficiencies; Several Hundred Amp Beam Current  
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6599  
(PULSE GENERATORS; POWER CONDITIONING)  
(Systems; Saturable Reactors)  
HIGH-VOLTAGE GENERATORS OF NANOSECOND PULSES  
M.Yu. Gel'tsel, A.D. Penfilov, V.S. Panasyuk, S.S. Sobolev and L.I. Yudin  
Institute Of Nuclear Physics, Academy of Sciences of the USSR, Novosibirsk, USSR  
Instruments And Experimental Techniques, No. 3, pp 613-618 (06/1966).  
Trans. From: Pribury Tekhnicheskoye Eksperimente 3, 101-107 (May-June 1966)  
Pulse generators are described providing voltage pulses of a duration from 5 to 30 nsec, 1 to 5 nsec rise times, and amplitudes up to 50 kV. The stability of delay between the trigger and output pulse is of the order of 1 nsec. Hydrogen thyristors are used as switching elements. The leading edge of the pulse is shaped by a nonlinear ferrite line, and its termination by a short-circuited cable section. 7 Refs.  
Primary Keywords: Pulse Generators; 5-30 nsec Voltage Pulse Duration; Hydrogen Thyristors; 50 kV Amplitude; Nonlinear Ferrite Line; Pulse Shaping Circuit; 1-5 nsec Rise Times  
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6603  
(POWER CONDITIONING)  
(Pulse Transformers)  
NEW PULSED X-RAY MACHINES, TYPE IRA-1 AND TYPE IRA-1D  
M.I. Komyak and E.A. Pel'ks  
Special Constructor Dept. Of X-ray Apparatus  
The Soviet Journal Of Non-destructive Testing, No. 5, pp 420-424 (10/1967).  
Trans. From: Defektoskopiya 5, 91-96 (September-October 1967)  
Pulsed x-ray machines having a transformer source for high voltage are described. It is demonstrated that the weight and size of x-ray machines are significantly reduced when a pulse transformer is used instead of a condenser bank to obtain the high voltage pulses. This permits the apparatus to be used both for studies of rapidly proceeding processes and for defectoscopy under field conditions. 6 Refs.  
Primary Keywords: Pulse Transformer; Pulse Generator; Weight And Size Reduced; Rapidly Proceeding Process Studies; Defectoscopy; Pulse Radiography; Short, High Intensity Pulses  
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6605  
(ELECTROMAGNETIC FIELD GENERATION)  
(Magnetic)  
PULSED MAGNETIC FIELD OF MASSIVE SOLENOID WITH MOVING CONDUCTING SHELL  
V.M. Mikhailov and E.I. Pis'mennyi  
Power Engineering, Vol. 16, No. 5, pp 63-68 (10/1978).  
Trans. From: Izvestiya Akademii Nauk SSSR, Energetika i Transport 16, 73-78 (1978)  
The authors study the expansion or compression of a conducting shell in a solenoid with a conducting core or die. The field distribution is calculated using a 1-dimensional formulation. 12 Refs.  
Primary Keywords: Pulsed Magnetic Field; Massive Solenoid; Conducting Die; Shell Displacement; Invariant Field Strength; Integrodifferential Equations; Theory  
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6607  
(ELECTROMAGNETIC FIELD GENERATION; PULSE GENERATORS)  
(Magnetic; Flux Compression)  
SOME CHARACTERISTIC FEATURES OF DIFFUSION OF A MAGNETIC FIELD INTO A MOVING CONDUCTOR  
E.I. Bichenkov  
Journal Of Applied Mechanics And Technical Physics, Vol. 8, No. 1, pp 90-91 (02/1968).  
Trans. From: Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki 8, 132-133 (1967)  
The study of the diffusion of a magnetic field into a moving conductor is of interest in connection with the production of high-strength magnetic fields by rapid compression of conducting shells. It is shown that when a magnetic field in a plane slit is compressed at constant velocity, the entire flux enters the conductor, in the present paper we formulate a general result concerning the conservation of the sum current in the cavity and conductor for arbitrary motion of the latter. We also consider a special case of conductor motion when the flux in the cavity remains constant despite the finite conductivity of the material bounding the magnetic field. 6 Refs.  
Primary Keywords: Magnetic Field; Diffusion Into A Conductor; Flux Compression; Constant Velocity Conductor Movement  
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6608  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
SPARK SOURCE IN A HIGH-CURRENT ELECTRON INJECTOR  
K.V. Suladze, A.A. Plyutto and D.V. Iremashvili  
Institute Of Physics And Technology, Academy Of Sciences, Geor. SSR,  
Sikhumi, USSR  
Instruments And Experimental Techniques, No. 3, pp 509-510 (06/1965).  
Trans. From: Priboiy i Tekhnika Eksperimenta 3, 46-47 (May-June 1965).  
The present article provides some of the results obtained in  
testing a spark source in an electron injector capable of producing a  
focused pulse electron beam with a current of 10 A for trapping  
voltage pulses with a duration of SE-8 sec and an amplitude of up to  
1E6 V. 5 Refs.  
Primary Keywords: Spark Source; High-current Electron Injector;  
Focused Electron Beam; 1E6 V Amplitude; 10 A Current  
Field Emission Diode  
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6609  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Systems)  
SPECIAL MEANS FOR MEASUREMENT OF THE ELECTRICAL PARAMETERS OF  
ELECTROPHYSICAL INSTALLATIONS  
M.P. Vasil'ev, V.P. Gerasimov, O.A. Gusev, V.P. Zhibure, V.G. Kunstman,  
I.V. Mozin, S.S. Repin and V.A. Skoserev  
Power Engineering, Vol. 16, No. 3, pp 57-60 (01/1978).  
Trans. From: Izvestiya Akademii Nauk SSSR, Energetika i Transport 16,  
65-69 (1978).  
Pulsed current and voltage measurements are vital to any  
installation that utilizes pulsed power. The authors describe design  
principles for equipment to measure voltages in the range of 50 kV 5  
MW and currents of over 1 MA. Data transmission in a pulsed power  
environment is also considered. 0 Refs.  
Primary Keywords: Electrical Diagnostics; Electrophysical  
Installations; Pulse Signals; High Accuracy; Ultra  
High Voltage Reduction; Measurement Converters;  
Direct-current Transformers; Data Transmission  
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6610  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
STUDY OF OPERATION OF CONTROLLED SPARK GAPS IN AIR  
P.I. Shkurepat  
Soviet Physics-Technical Physics, Vol. 5, No. 8, pp 895-902 (02/1961).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 30, 956-963 (August 1960).  
A study was made of the relation between the breakdown time lag of  
controlled spark gaps in air at atmospheric pressure and various  
trigger conditions. On the basis of the experimental data obtained a  
mechanism for the development of the discharge in triggered spark  
gaps is proposed. A recommended design for a controlled spark gap  
with a short time lag is given. 6 Refs.  
Primary Keywords: Spark Gap Breakdown; Trigger Variation; Breakdown  
Time; Breakdown Mechanism; Sphere-sphere Gap;  
Aluminum Electrodes; Steel Insert  
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6612  
(PULSE GENERATORS; POWER CONDITIONING)  
(Systems; Pulse Transformers)  
TRANSFORMERS FOR HEAVY-CURRENT NANOSECOND IMPULSES  
B.M. Koval'chuk, V.V. Kramnev and G.A. Mesyats  
Academy of Sciences of the USSR, Tomsk, USSR  
Instruments And Experimental Techniques, No. 3, pp 672-676 (06/1969).  
Trans. From: Priboiy i Tekhnika Eksperimenta 3, 125-129 (May-June 1969).  
A procedure has been developed for calculating transformers for  
nanosecond current impulses based on segments of long lines using  
ferrites as decoupling elements. Results of an experimental check of  
the proposed method are given. Transformer constructions are  
described that deliver current impulses of up to 1E3 A of 1E-7 to  
1E-8 sec duration, with a front length of 1E-9 sec on a load of 0.2  
to 2 ohm. 6 Refs.  
Primary Keywords: Nanosecond Current Impulses; Pulse Transformers; 1E3  
A Current Impulses; 1E-9 sec Pulse Front; Low Output  
Impedance  
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6613  
(POWER TRANSMISSION)  
(Transient Effects)  
TRANSIENT ELECTROMAGNETIC PROCESSES IN DEVICES WITH HEAVY CURRENT LEADS  
V.M. Mikhailov  
Power Engineering, Vol. 16, No. 4, pp 41-48 (08/1978).  
Trans. From: Izvestiya Akademii Nauk SSSR, Energetika i Transport 16,  
48-55 (1978).  
The authors present an analysis of transients in the environment  
surrounding cables carrying high current pulses. The fields  
surrounding the cables are calculated numerically for a rectangular  
cross-section bus and the crosstalk to another rectangular bus is  
also calculated. 13 Refs.  
Primary Keywords: Field Calculation; Numerical Formulations; Plane  
Pulse Electromagnetic Field; Heavy Current Leads;  
Transient Regimes; High Current Energy Transport  
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6617  
(POWER CONDITIONING)  
(Saturation Reactors)  
A CIRCUIT USING FERRITES TO OBTAIN HIGH-VOLTAGE NANOSECOND PULSES  
R.B. Bakst and G.A. Mesyats  
Tomsk Polytechnic Institute, Tomsk, USSR  
Instruments And Experimental Techniques, No. 3, pp 598-600 (06/1964).  
Trans. From: Priboiy i Tekhnika Eksperimenta 3, 108-110 (May-June 1964).  
The authors describe a circuit for generating short pulses with  
amplitudes of up to 20 kV by means of a nonlinear element with  
ferrite toruses in a cable propagating a voltage pulse. They give  
data about the influence of parameters of propagating pulses on the  
shape and amplitude of the output signal. 3 Refs.  
Primary Keywords: Pulse Shaping; Nanosecond Pulses; 20 kV  
Amplitudes; Ferrite Toruses  
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6618  
(PULSE GENERATORS)  
(Pulse Forming Lines)  
A SUPPLY GENERATOR FOR A STREAMER CHAMBER WITH A LARGE INTERELECTRODE  
GAP  
G.A. Vorob'ev, M.S. Rudenko, V.I. Tsvetkov and M.I. Kozlov  
Tomsk Polytechnic Institute, Tomsk, USSR  
Instruments And Experimental Techniques, No. 1, pp 65-68 (02/1967).  
Trans. From: Priboiy i Tekhnika Eksperimenta 1, 68-71  
(January-February 1967).

Spark chambers that operate in the streamer (track) mode permit  
the isotropy of the recording of particle tracks to be increased  
considerably. The development of electron avalanches and streamers in  
neon is defined in times of 1E-8 to 1E-9 sec at field strengths of  
7-15 kV/cm. When the chamber gap d=10-20 cm, a pulse with an  
amplitude on the order of hundreds of kV, a controllable duration on  
the order of tens of nsec, and a duration stability of not worse than  
1E-9 sec is required. The proposed generator for chamber supply was  
developed on the basis of the generator proposed previously, which  
produced pulses with an amplitude of 500 kV and higher and a rise  
time of 1-2E-9 sec. In order to limit the pulse duration with  
acceptable accuracy, the main attention was given to the development  
of spark gaps and methods of connecting them. 3 Refs.  
Primary Keywords: Pulse Generator; Streamer Chamber; 500 kV Amplitude  
Pulses; 1-2E-9 sec Rise Time  
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6619  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
A TRIGATRON FOR LARGE CURRENTS IN HIGH-VOLTAGE APPARATUS  
S.A. Smirnov, A. Hrkienko and A.M. Shendrovich  
Physicstechnical Institute, Academy of Sciences of the Ukrainian SSR,  
Khar'kov, USSR  
Instruments And Experimental Techniques, No. 3, pp 503-506 (06/1961).  
Trans. From: Priboiy i Tekhnika Eksperimenta 3, 89-93 (May-June 1961).  
A trigatron is described which can handle currents up to 2.5 kA at  
voltages from 20 to 60 kV for a pulse duration of 2.7 microseconds  
and a repetition frequency of 50 cycles. 7 Refs.  
Primary Keywords: Trigatron Spark Gap; 2.5 kA Current Capacity; 60 kV  
Operating Voltage; Rep-rated; Life Test  
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6620  
(PULSE GENERATORS; PULSE GENERATORS)  
(Merx; Pulse Forming Lines)  
A 500-KV NANOSECOND PULSE GENERATOR  
G.A. Vorob'ev and M.S. Rudenko  
Tomsk Polytechnic Institute, Tomsk, USSR  
Instruments And Experimental Techniques, No. 1, pp 106-108 (01/1965).  
Trans. From: Priboiy i Tekhnika Eksperimenta 1, 109-111 (January 1965).  
A 500-kV generator of pulses with a front of 1.5 nsec is  
described. The generator consists of a storage capacitor, in which  
glycerine is used as the dielectric, a pressurized discharge chamber,  
and a transmission line. The storage capacitor is charged from a  
single-stage pulse generator. Owing to the coaxial design of the  
storage capacitor-transmission line system, the dimensions of the  
discharge circuit could be reduced and a steep pulse front could be  
obtained. 8 Refs.  
Primary Keywords: 500 kV Pulse Generator; 1.5 nsec Pulse Front;  
Storage Capacitor; Pressurized Discharge Chamber;  
Transmission Line  
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6621  
(ELECTROMAGNETIC FIELD GENERATION; PULSE GENERATORS)  
(Magnetic; Flux Compression)  
AN APPROXIMATE THEORY OF MAGNETIC PILE-UP  
M.N. Kalitkin and L.S. Tsareva  
Magneto-hydrodynamics, Vol. 5, No. 3, pp 5-9 (09/1969).  
Trans. From: Magnitnaya Gidrodinamika 5, 8-14 (1969).  
The compression of the magnetic field of a moving shell is  
considered when the shell exhibits finite conductivity and becomes  
heated in the process of compression. The envelope material is taken  
to be an incompressible fluid (which is justifiable for fields of up  
to 3-4 million Oe), and the magnetic field diffusion in the envelope  
is taken into account by the skin-layer method. With these  
assumptions the mathematical problem reduces to the solutions of a  
system of three ordinary differential equations, which may be solved  
exactly in a number of cases. The mechanical calculations which were  
carried out are in good agreement with experiment. 14 Refs.  
Primary Keywords: Magnetic Field Compression; Magnetic Field  
Diffusion; Magnetic Pile-up; Magneto-hydrodynamic  
Equations; Theory  
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6622  
(ENERGY STORAGE, CAPACITIVE; ELECTROMAGNETIC FIELD GENERATION)  
(Capacitor Banks; Magnetic)  
APPARATUS FOR GENERATING INTENSE MAGNETIC FIELDS OF SHORT DURATION  
E.I. Kondorskii and E.V. Susov  
Instruments And Experimental Techniques, No. 1, pp 118-123 (02/1963).  
Trans. From: Priboiy i Tekhnika Eksperimenta 1, 125-130  
(January-February 1963).  
Apparatus for producing intense short-duration magnetic fields of  
up to 0.9E6 Oe is described. The magnetic field pulse is produced by  
discharging a capacitor bank of nominal energy 13.5 kJ. Construction  
of solenoids and switches is described. 8 Refs.  
Primary Keywords: Magnetic Field Generation; Intense, Short-duration  
Fields; 13.5 kJ Nominal Energy Capacitor Bank; 3000  
Microfarad Total Capacitance; Copper Wound Solenoids  
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6623  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
CALCULATION OF THE VOLTAGE IMPULSE IN ELECTRIC EXPLOSION OF CONDUCTORS  
V.L. Budovich and I.P. Kuzhakin  
Moscow Energetics Institute, Moscow, USSR  
Electric Technology USSR, Vol. 95, No. 1, pp 24-32 (01/1975).  
Trans. From: Elektrichestvo 95, 22-26 (1975).  
The voltage pulse associated with the electrical explosion of a  
wire is studied theoretically in this paper. The voltage peak is  
calculated analytically using a series arc model. Comparison with  
experiment shows good agreement. 16 Refs.  
Primary Keywords: Slow Electric Explosion; Voltage Impulse Parameters;  
Conductor Dimensions; Serial-arc Theory  
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6624  
(POWER CONDITIONING)  
(Saturable Reactors)  
CONTROLLED DELAY OF HIGH-POWER NANOSECOND PULSES WITH THE USE OF THE  
MAGNETIZATION REVERSAL TIME OF FERRITES  
R.B. Bakst, A.S. El'chaninov and G.A. Mesyats  
Tomsk Polytechnic Institute, Tomsk, USSR  
Instruments And Experimental Techniques, No. 4, pp 893-895 (08/1968).  
Trans. From: Pribury i Tekhnika Eksperimenta 4, 124-126 (July-August  
1968)  
A controlled delay system for high-power nanosecond pulses that is  
assembled from ferrite elements is described. The system ensures  
smooth variation of the delay in an interval of 0 to 50 nsec for a  
pulse of 5 to 15 kV amplitude and a leading edge of 3 nsec. The delay  
stability is not worse than 1% of the maximum delay. 6 Refs.  
Primary Keywords: Nonlinear Inductor; Magnetization Reversal Time;  
Controlled Delay System; High-power Nanosecond  
Pulses; Self-inductive Ferrite Element  
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6628  
(BREAKDOWN STUDIES)  
(Liquid, Electrical)  
EXPANSION OF A SPARK CHANNEL IN A LIQUID  
Yu.V. Skvortsov, V.S. Komal'kov and N.M. Kuznetsov  
Soviet Physics-Technical Physics, Vol. 5, No. 10, pp 1100-1112  
(04/1961).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 30, 1165-1177 (October 1960)  
An investigation has been made of the initial stages of expansion  
of the channel of an intense spark in water for currents up to 7.5ES  
amp in the discharge circuit and a rate-of-rise of 2E11 amp/sec. The  
rate of expansion of the channel boundaries, the velocity of the  
shock wave, the voltage in the spark channel, and the discharge time  
have been measured. Estimates are given of the conductivity and  
current density in the discharge channel. A hydrodynamic calculation  
of the pressure field and the velocity behind the shock-wave front is  
presented. 10 Refs.  
Primary Keywords: Spark Channel Expansion; 7.5ES Amp Currents; 2E11  
Amp/sec Rate-of-rise; Hydrodynamic Pressure Field  
Calculation; Plasma Conductivity; Current Density  
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6632  
(SWITCHES, CLOSING)  
(Gas Gaps, Systems)  
INDUCTANCE OF MULTICHANNEL HIGH-VOLTAGE DISCHARGERS  
A.P. Komarov and I.M. Romanenko  
Soviet Electrical Engineering, Vol. 50, No. 7, pp 55-59 (07/1979).  
Trans. From: Elektrotehnika 50, 27-29 (1979)  
Low-inductance, multichannel gas switching is the subject of this  
paper. Several types of multichannel operation are considered  
quantitatively. Several configurations from parallel operation of  
conventional spark gaps to creeping surface discharge switches are  
considered. 5 Refs.  
Primary Keywords: Parallel Spark Gap Operation; Multichannel  
High-voltage Dischargers; Small Power Demand; 1-2 nH  
Minimum Inductance; Fast Rise Time; Low Erosion;  
Creeping Discharge Switch  
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6635  
(ENERGY CONVERSION, ELECTRICAL)  
(Charging Circuits)  
INVESTIGATION OF RECTIFIER UNITS FOR PERIODIC CHARGING OF STORAGE  
CAPACITORS  
A.E. Krasnopol'skii, L.F. Lebedev and V.B. Sokolov  
Soviet Electrical Engineering, Vol. 50, No. 10, pp 58-63 (10/1979).  
Trans. From: Elektrotehnika 50, 25-28 (1979)  
Capacitor charging circuits are described which use inductive and  
combination capacitive-inductive current limiting in the secondary  
circuit. Efficiencies as high as 85% are reported with almost total  
power factor compensation possible. A split-phase arrangement is  
used. 3 Refs.  
Primary Keywords: Capacitor Charging Circuit; Split-phase Circuit;  
Inductive Limiting; Capacitive-inductive Limiting;  
High Efficiency; Experiment; Theory  
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6637  
(BREAKDOWN STUDIES)  
(Suspensions, Electrical)  
MECHANISM OF SURGE BREAKDOWN IN SUSPENSIONS  
A.A. Vorob'ev, M.P. Tonkonogov and F.D. Fominykh  
Soviet Physics Journal, Vol. 11, No. 7, pp 69-70 (07/1968).  
Trans. From: Izvestiya Vysshikh Uchebnykh Zavedenii. Fiziki 11,  
103-105 (1968)  
Data are presented of the breakdown of suspensions of several  
solid materials in liquid dielectrics. Both dielectric and conducting  
particles are used in several dielectric liquids. Graphs are  
presented for several combinations of liquid and solid. 7 Refs.  
Primary Keywords: Liquid Breakdown; Suspension Breakdown; Pulsed  
Dielectric Strength; Solid-phase Concentration  
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6638  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
METHOD OF MEASURING THE DISPERSION OF THE DELAY TIMES OF BREAKDOWN OF  
CONTROLLED SPARK GAPS  
I.I. Aksenov, V.K. Bocharov, V.L. Golosnyak, A.L. Zhdanov, V.I. Slatin  
and S.A. Smirnov  
Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR,  
Khar'kov, USSR  
Instruments And Experimental Techniques, No. 3, pp 753-754 (06/1968).  
Trans. From: Pribury i Tekhnika Eksperimenta 3, 232 (May-June 1968)  
The most complete information on the stability of operation of  
spark gaps (distribution of the delay time, mathematical expectation  
of this quantity, variance, etc.) can be obtained by the method  
described in a previous paper. However, measurement by this method,  
based on statistical analysis of numerous oscillograms obtained by  
photographing each pulse on a separate frame, is a quite laborious  
process. The shortcoming of the method is especially felt when many  
measurements must be made. Expenditures of time and labor are greatly  
lessened by using the below-described method based on automatic  
photographing of the oscillograms with subsequent processing of the  
photographs by a computer. The investigated signals are photographed  
from the screen of a pulse oscillograph by an ordinary narrow-film  
camera, the reverse winding handle of which is connected to the  
film-advancing mechanism. As such a mechanism we can use the magnetic  
drive of a selector. The winding of the drive is supplied from the  
control unit, to the input of which are sent synchronizing pulses  
from the firing unit of the investigated spark gap. Each time after  
operation of the spark gap the drive moves the film 1.5-2 mm. When  
the film is completely rewound the protection device of the control  
unit de-energizes the supply circuit of the magnetic drive and  
switches on the signalling system. 3 Refs.  
Primary Keywords: Controlled Spark Gaps; Delay Time Distribution;  
Oscillograms; Computer Processing; Jitter  
Measurement; Automatic Data Recording  
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6640  
(PULSE GENERATORS)  
(Pulse Forming Lines)  
OBTAINING HIGH-VOLTAGE SQUARE PULSES  
A.I. Pavlovskii and G.V. Sklizkov  
Instruments And Experimental Techniques, No. 2, pp 328-322 (04/1962).  
Trans. From: Pribury i Tekhnika Eksperimenta 2, 98-100 (March-April  
1962)  
The paper describes a new method for obtaining square pulses whose  
amplitude exceeds the charging voltage applied to the transmission  
line which forms the pulses by a factor of several times. The circuit  
and construction are cited for an oscillator which produces a square  
pulse with an amplitude of 160 kV and a current of 600 amp when it  
operates into a matched load of 250 ohm, and a pulse amplitude of up  
to 300 kV when it operates into a load of 200 kohm. 0 Refs.  
Primary Keywords: 160 kV Square Pulse Amplitude; 600 Amp Current; Long  
Coaxial Cables; .25 Microsecond Duration; 250 Ohm  
Impedance  
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6641  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
ON THE USE OF GAS-DISCHARGE MICROGAPS IN HIGH-VOLTAGE NANOSECOND PULSE  
DEVICES  
G.A. Mesyats, P.A. Vorob'yev and Yu.I. Bychkov  
Radio Engineering And Electronic Physics, Vol. 10, No. 4, pp 668-670  
(04/1965)  
Trans. From: Radiotekhnika i Elektronika 10, 780-782 (1965)  
The authors discuss the use of spark gaps as switches and pulse  
sharpening devices in this paper. The variation of switching time with  
field intensity is found empirically for single gaps and a formula is  
given for cascaded gaps. Experimental tests are performed. 6 Refs.  
Primary Keywords: Gas-discharge Microgaps; Spark Gas-discharge  
Switches; Stroboscopes; Jitter Measurement; Empirical  
Delay Formula; Spark Gap System  
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6644  
(POWER CONDITIONING)  
(Saturable Reactors)  
SHORTENING THE FRONTS OF HIGH-VOLTAGE PULSES WITH THE AID OF A  
NONLINEAR INDUCTANCE  
O.G. Ilin and A.M. Shanderovich  
Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR,  
Khar'kov, USSR  
Instruments And Experimental Techniques, No. 1, pp 109-110 (02/1965).  
Trans. From: Pribury i Tekhnika Eksperimenta 1, 112-113  
(January-February 1965)  
A method of shortening pulse fronts with the aid of a nonlinear  
inductance (for example, a coil with a ferrite core) connected in  
series with a load is described. The parameters of the inductance are  
such that during a time equal to the duration of the front of a pulse  
from the shaper its value will be high. Therefore, the current rise  
during the time of the front will occur very slowly. Up until the end  
of the front, the core is saturated, the inductance is considerably  
reduced, and a fast current rise occurs. Oscillograms illustrating  
shortening of the front by the described method of from 30 to 7 nsec  
are given. 4 Refs.  
Primary Keywords: Pulse Front Sharpening; Nonlinear Inductance; High  
Voltage Pulses; Core Saturation; Several  
Configurations  
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6646  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
SUPPLY AND CONTROL OF AN ACCELERATOR ACTING ON THE PRINCIPLE OF A TESLA  
TRANSFORMER  
A.A. Egorov, V.S. Panasyuk and V.M. Radchenko  
Institute Of Nuclear Physics, Academy of Sciences of the USSR,  
Novosibirsk, USSR  
Instruments And Experimental Techniques, No. 2, pp 261-265 (04/1968).  
Trans. From: Pribury i Tekhnika Eksperimenta 2, 18-23 (March-April  
1968)  
Described are charging units which were developed in conformity  
with the construction of a Tesla transformer, used as an element of a  
direct action accelerator. The units can also be used in other cases.  
A circuit, operationally controlled by an electron beam current set  
below the accelerating potential, is described. 4 Refs.  
Primary Keywords: E-beam Generation; Tesla Transformer; Direct Action  
Accelerator; Hydrogen Thyatrons; Supply Network;  
Grid Voltage  
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6648  
(ELECTROMAGNETIC FIELD GENERATION; PULSE GENERATORS)  
(Magnetic; Flux Compression)  
THE ELECTROMAGNETIC FIELD IN A CAVITY UNDERGOING COMPRESSION  
I.M. Rutkevich  
Moscow, USSR  
Journal Of Applied Mathematics And Mechanics, Vol. 31, No. 3, pp 578-585 (06/1967).  
Trans. From: Prikladnaya Matematika I Mekhanika 31, 552-559 (1967)  
A theory of magnetic flux compression is presented. The authors consider flux compression by a perfectly conducting boundary in plane and axisymmetrical geometries. The method of integral transformations is used to obtain an analytical solution to the compression problem. 9 Refs.  
Primary Keywords: Magnetic Flux Compression; Extra-strong Magnetic Fields; Compressing Conducting Shells;  $10^4$  T Field Intensities; Homogeneous Magnetic Field; Integral Representations

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6652  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Current)  
A COMPENSATED SHUNT FOR MEASUREMENT OF POWERFUL NONSTATIONARY CURRENTS  
A.P. Raikov, L.S. Gerasimov and A.M. Iskol'dskii  
Institute Of Automation And Electrometry, Academy of Sciences of the USSR, Novosibirsk, USSR  
Instruments And Experimental Techniques, Vol. 16, No. 6, pp 1744-1745 (12/1973).  
Trans. From: Pribery i Tekhnika Eksperimenta 6, 112-113 (November-December 1973)  
The construction of a compensated shunt for measurement of megampere currents having a rise time of  $10^{-8}$  sec is described. Oscillograms of the currents recorded by means of the proposed shunt are presented. 2 Refs.  
Primary Keywords: Compensated Shunt; 10 MA Current Range; 10 ns Rise Time; RL Circuit  
Secondary Keywords: Exploding Wires  
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6654  
(PARTICLE BEAMS, ION)  
(Generation)  
ACCELERATION OF IONS BY A RELATIVISTIC ELECTRON BEAM  
A.A. Plyutto, K.V. Suladze, S.M. Tamchin, G.P. Mkhaidze, E.D. Korop, B.A. Tskhadaya and I.V. Golovin  
Soviet Physics-Technical Physics, Vol. 18, No. 8, pp 1026-1028 (02/1974)  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 43, 1627-1631 (August 1973)  
The acceleration of ions by a relativistic electron beam is investigated. Protons are accelerated to 6-7 MeV by a beam of approximately 1 MeV electrons. The compositions of the beam and their energy distribution are studied. It is shown that the energies of protons accelerated by electrons increase more rapidly than linearly with increase in the accelerating voltage in the range 0.3-1 MeV. 11 Refs.  
Primary Keywords: Collective Acceleration; 7 MeV Ion Beam Energy; Beam Diagnostics; Beam Profile Measurement  
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6655  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
ACCELERATION OF IONS IN AN ELECTRON BEAM  
A.A. Plyutto, K.V. Suladze, S.M. Tamchin and E.D. Korop  
Soviet Atomic Energy, Vol. 27, pp 1197-1202 (11/1969)  
Trans. From: Atomnaya Energiya 27, 418-423 (November 1969)  
In the production of ion beams derived from vacuum spark plasma, particles have been observed with energy in excess of the accelerating potential. Further investigation has led to the observation of an effective process of acceleration of ions up to energies approximately 1-10 MeV, produced during formation of electron beams from a plasma. The present article gives an account of some results of investigating the process of acceleration of ions in electron beams during emission from the plasma produced by vacuum sparks. 9 Refs.  
Primary Keywords: Collective Acceleration; Vacuum Spark Plasma; E-beam Generation; Ion Beam Generation  
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6657  
(PULSE GENERATORS)  
(Flux Compression)  
CALCULATING SCHEME AND SWITCHING-ON OF THE LOAD OF PLANE EXPLOSIVE-DRIVEN MAGNETIC GENERATORS  
E.I. Bichenkov, A.E. Voltenko, V.A. Lobanov and E.P. Metochkin  
Novosibirsk, USSR  
Journal Of Applied Mathematics And Technical Physics, Vol. 14, No. 2, pp 176-180 (04/1973).  
Trans. From: Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki 2, 37-41 (March-April 1973)  
A scheme is described for calculating explosive-driven magnetic generators, and analytical and numerical calculations are made of the problems of switching a generator onto a constant ohmic and induction load, to a load whose resistance rises linearly with the temperature, and to a plasma load with equilibrium radiation. In the latter case, a calculation is made of a variant involving switching on the load through a matched transformer. 9 Refs.  
Primary Keywords: Flux Compression Generator; Analysis; Numerical Calculation; Output Switch Analysis; Several Load Types  
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6660  
(PARTICLE BEAMS, ELECTRON; ENERGY STORAGE, INDUCTIVE; SWITCHES, OPENING)  
(Generation; Systems; Explosive Fuses)  
DIRECT-ACTION ACCELERATORS WITH INDUCTIVE ENERGY STORAGE AND EXPLODING CONDUCTORS  
Yu.D. Bakulin, V.S. Diyanov, V.P. Kovalev, A.I. Kornilitsyn, B.M. Lavrenko, A.V. Luchinskii and V.I. Martynov  
Instruments And Experimental Techniques, Vol. 22, No. 2, pp 323-326 (04/1979).  
Trans. From: Pribery i Tekhnika Eksperimenta 2, 34-37 (March-April 1979)

Two generators of pulsed bremsstrahlung and electron beams are described, the IGUR-I and IGUR-II instruments, in which inductive storage devices with exploding conductors are used. At a voltage of 2.8 MV on the accelerator tube and a current of 44 kA through the tube the IGUR-I provides a bremsstrahlung dose of 110 R at a distance of 1 m from the anode, while the IGUR-II at a voltage of 3.7 MV on the tube and a current of 70 kA provides a dose of 700 R. On both instruments the half-width of the bremsstrahlung pulse is regulated in the range of 0.1-0.5 microsecond. Electron beams with an energy density of 300 J/sq.cm. are extracted from the accelerator tubes. 1 Refs.  
Primary Keywords: E-beam Generation; Inductive Energy Storage; Opening Switch; 2.8 MV Operating Voltage  
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6661  
(BREAKDOWN STUDIES)  
(Gas; RF)  
DYNAMICS OF THE DEVELOPMENT OF HIGH-CURRENT INDUCTION DISCHARGE  
P.M. Beronets, V.I. Myshenkov and M.I. Yakushin  
Moscow, USSR  
Journal Of Applied Mechanics And Technical Physics, Vol. 20, No. 3, pp 305-311 (06/1979).  
Trans. From: Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki 3, 58-67 (May-June 1979)  
Pulsed high-current discharges in the range of relatively low pressures were investigated mostly in connection with the problem of controlled thermonuclear fusion. The need for investigating such discharges at elevated pressures was dictated to a considerable extent by the requirement for high-power light sources. Significant advances in investigating the structure and dynamics of the development of high-current discharges have now been achieved. However, there also remain unsolved problems. In particular, with regard to pulsed induction discharges, complete understanding of the mechanism of development of such discharges is still lacking. Our purpose is to investigate high-current induction discharges in argon under gas pressures in the range from 5 to 50 mm Hg. A physical interpretation of individual stages in the development of high-current discharges is given on the basis of an analysis of the experimental results, and the stages of discharge development, the mechanism of which is not yet fully understood, are discussed. The discharge is investigated for relatively low energy inputs, when it is possible to separate in time the various stages of discharge development, which occur virtually simultaneously at high energy inputs. 8 Refs.  
Primary Keywords: Induction Breakdown; 20 kHz Frequency; 70 V/cm Field Strength; Azimuthal E-field; Experiment; Theory  
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6663  
(ENERGY STORAGE, INDUCTIVE; ELECTROMAGNETIC LAUNCHERS)  
(Systems; Plasma)  
EFFECT OF INTERRUPTION TIME ON PLASMOID ACCELERATION IN AN INDUCTIVE ENERGY-STORAGE ACCELERATOR  
N.V. Belan, N.A. Mashtylev and B.I. Panachevnyi  
Soviet Physics-Technical Physics, Vol. 16, No. 3, pp 433-435 (09/1971).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 41, 559-562 (March 1971)  
Plasmod acceleration is discussed for an accelerator with inductive energy storage; it is assumed that a self-sustained arc is produced in the switching system. The plasmod acceleration process is characterized by two stages: in the first the acceleration is due to power from the source; in the second the acceleration is due to the stored energy. A faster interruption time yields higher efficiency in acceleration in injectors of this kind. 5 Refs.  
Primary Keywords: Plasmod Acceleration; Inductive Energy Storage; Interruption Time; Charging Circuit; High Efficiency; Switching System; Self-sustained Arc  
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6664  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
ELECTRIC EXPLOSION OF SPIRAL WIRES IN VACUUM  
I.F. Kvartskhava, V.V. Bondarenko, P.D. Meladze and K.V. Suladze  
Soviet Physics JETP, Vol. 35 (8), No. 4, pp 634-638 (04/1959).  
Trans. From: Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki 35, 911-916 (October 1958)  
When a bent wire is exploded in vacuo, the motion of the explosion products through the magnetic field of the current produces current tubes and also certain glow effects, due to the interaction of the streams of explosion products with each other. By scanning the explosion with a mirror, the stream fronts were found to have a speed of  $10^6$  cm/sec. A possibility of thermally insulating the plasma by means of the strong magnetic field that exists during a very short time of explosion is demonstrated. A qualitative explanation is proposed for the observed effect. 8 Refs.  
Primary Keywords: Exploding Wire; Spiral Wire; Magnetic Field; Current Tubes;  $10^6$  cm/sec Stream Front Speed  
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6666  
(BREAKDOWN STUDIES)  
(Exploding Wires)

ELECTRICAL EXPLOSION OF WIRES IN VACUUM

I.F. Kvarshcheva, V.V. Bondarenko, R.D. Meladze and K.V. Suladze  
Soviet Physics JETP, Vol. 4, No. 5, pp 637-644 (1975)  
Trans. From: Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki 31, 737-744 (November 1956)

Results of an investigation of electric explosions of wires in vacuum are described. It is shown that regardless of the initial shape of the wire the explosion products propagate as in an ordinary explosion, in a direction normal to the surface of the wire. If the voltage across the capacitor of the explosion circuit is relatively low, the vapor streams, as in the case of an explosion in air, from layers that range themselves perpendicular to the wire. It has been established that at high capacitor voltages the motion of the vapor streams affects the distribution of the discharge current in the space around the wire. A qualitative explanation is given for the observed effects. 7 Refs.

Primary Keywords: Vacuum; Discharge Currents; Current Channel; Electrode Streamers; Exploding Wire; Geometry; Independence

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6668

(BREAKDOWN STUDIES, PARTICLE BEAMS, ELECTRON)

(Vacuum; Electrical; Generation)

ELECTRON EMISSION PROPERTIES OF A VACUUM SPARK. II. ELECTRON BEAMS

K.V. Suladze and A.A. Flyutse

Soviet Physics Technical Physics, Vol. 12, No. 1, pp 48-52 (07/1967)

Details are given of the emission properties of the plasma of a vacuum spark that arises in the production of a high-current electron beam. An emitting surface of 5-7 sq cm can produce current densities of 100-250 A/cm<sup>2</sup> in a pulse of duration 10<sup>-6</sup> sec. Certain features of the high-current beams have been studied by extraction of electrons from the plasma; this occurs in two stages. In the first stage the extracted current is independent of the voltage and is proportional to the plasma density. The anomalous resistance of the plasma is due to deceleration of the electrons by the waves excited at the onset of instability. The second stage shows a sudden increase in the current. 29 Refs.

Primary Keywords: Vacuum Breakdown; E-beam Generation; Plasma Emission; Anomalous Plasma Resistivity; Two Beam Generation Stages

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6671

(PARTICLE BEAMS, ELECTRON; SWITCHES, OPENING)

(Generation; Explosive Fuses)

EXPLODING FOILS FOR ACCELERATOR APPLICATIONS

A.B. Andreev, V.A. Burtsev, V.M. Vodovozov and A.A. Drozdov

Soviet Technical Physics Letters, Vol. 5, No. 2, pp 68-69 (02/1979)

Trans. From: Pis'ma Zhurnal Tekhnicheskoi Fiziki 5, 172-175 (February 1979)

The traditional design of high-current nanosecond electron accelerators uses sheath lines and Marx generators. Another approach makes use of exploding wires to generate the high-voltage pulses. This approach is attractive because it is simpler than the traditional approach and because inductive energy storage holds promise. 5 Refs.

Primary Keywords: E-beam Generation; High-voltage Pulses; Exploding Foils; Inductive Energy Storage; 10 kA Peak Beam Current; Capacitive Inductor Charging

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6672

(PULSE GENERATORS; ENERGY STORAGE, CHEMICAL)

(Flux Compression; Flux Compression Generators)

EXPLOSIVE GENERATORS

E.I. Bichenkov

Institute Of Hydrodynamics, Academy of Sciences of the USSR, Moscow, USSR

Soviet Physics-Doklady, Vol. 12, No. 6, pp 567-569 (12/1967)

Trans. From: Doklady Akademii Nauk SSSR 174, 779-782 (June 1967)

In this paper, the results are discussed of experiments carried out in the Institute of Hydrodynamics, Siberian Branch of the Academy of Sciences of the USSR on the construction of explosive devices which convert explosive energy into magnetic field energy. Such devices have been called explosive generators. 4 Refs.

Primary Keywords: Explosive Generation; Explosive Driver; Design Considerations; Performance; etc.

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6673

(PULSE GENERATORS)

(Flux Compression)

FLUX DIFFUSION DURING MAGNETIC ACCUMULATION IN NARROW CAVITIES

E.I. Bichenkov and E.P. Matochkin

Novosibirsk, USSR

Journal Of Applied Mechanics And Technical Physics, Vol. 15, No. 4, pp 555-559 (08/1974)

Trans. From: Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki 4, 148-152 (July-August 1974)

An equation is obtained for the flux diffusion during the compression of a uniform magnetic field in a flat gap. Calculations are made for fast and slow pumping of the cavity by the initial current and for a constant linear increase and an increase proportional to the square root of the initial current. It is shown that the flux losses are considerably less for large magnetic Reynolds numbers; the flux losses depend essentially on the pumping time and depend little on the shape of the pumping current pulse. 7 Refs.

Primary Keywords: Flux Compression; Flat Gap; Field Diffusion; Magnetic Reynolds Number; Current Pump; Pumping Speed

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6674

(ELECTROMAGNETIC FIELD GENERATION; PULSE GENERATORS)

(Magnetic; Flux Compression)

FLUX DIFFUSION UPON THE COMPRESSION OF A MAGNETIC FIELD BY FLAT STRIPS

E.I. Bichenkov and E.P. Matochkin

Novosibirsk, USSR

Journal Of Applied Mechanics And Technical Physics, Vol. 15, No. 4, pp 865-868 (12/1974)

Trans. From: Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki 6, 159-162 (November-December 1974)

An equation is obtained describing the flux diffusion in flat profiled generators having magnetic cumulation (MC). The critical modes of operation of such generators on active and inductive loads are calculated. 4 Refs.

Primary Keywords: Magnetic Flux Compression; Flux Diffusion; Magnetic Cumulation; Powerful Pulsed Currents; Superstrong Magnetic Fields; Magnetic Flux; Flux Losses; Strip Conductance Constant; Load Resistance Constant

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6675

(ELECTROMAGNETIC FIELD GENERATION; PULSE GENERATORS)

(Magnetic; Flux Compression)

FLUX LOSSES DURING COMPRESSION OF A MAGNETIC FIELD BY FLAT STRIPS

E.I. Bichenkov and V.A. Lehanov

Novosibirsk, USSR

Journal Of Applied Mechanics And Technical Physics, Vol. 16, No. 2, pp 216-219 (05/1975)

Trans. From: Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki 2, 154-158 (March-April 1975)

The compression of a magnetic field by a moving conductor-magnetic cumulation is used to obtain powerful magnetic fields and large pulsed currents. The potentialities of magnetic cumulation are determined mainly by the flux losses due to diffusion of the magnetic field into the conductor surfaces. Experiments on the compression of a magnetic field by flat strips of copper and Dural are described in the report; and a comparison is made with the calculation of diffusional flux losses. The possible role of a gutter instability of the copper conductors is evaluated for the explanation of the increase in flux losses when a critical linear current density, whose value in the experiments presented was 180-210 kA/cm, is exceeded in the strips. 4 Refs.

Primary Keywords: Magnetic Field Compression; Magnetic Cumulation; Powerful Magnetic Fields; Large Pulsed Currents; Flux Losses; Flat Strips

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6676

(POWER CONDITIONING)

(Pulse Transformer)

HIGH-VOLTAGE MEGA-AMPERE CABLE TRANSFORMER

G.S. Villeval'd, V.N. Krasyuk and G.I. Sil'vestrov

Institute Of Nuclear Physics, Academy of Sciences of the USSR, Novosibirsk, USSR

Instruments And Experimental Techniques, Vol. 20, No. 4, pp 1105-1106 (08/1977)

Trans. From: Priroda i Tekhnika Eksperimenta 4, 166-168 (July-August 1977)

A cable transformer, without iron, with a voltage transformation factor of n=2 or n=4 in the primary 50 kV or 100-50 kV loop, respectively, and 10 kV in the load loop is described. The cable transformer is used in the transformer, and the number of parallel branches is 12. The scattering inductance, referred to the load loop is 1/2 sub 50 = 5 nH for n=2 (1/2 sub 50 = 6 nH for n=4). Diagrams of working versions of generators using the transformer are presented. 3 Refs.

Primary Keywords: Cable Transformer; 25 kV Output Voltage; 50 kV Input Voltage; Low-Inductance Load; Scattering Inductance; 2 MA Current; 100-200 kHz Discharge Frequency

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6677

(ENERGY STORAGE, INDUCTIVE; PARTICLE BEAMS, ELECTRON)

(Switches, Generation)

INCREASING ELECTRON BEAM POWER BY INDUCTIVE ACCUMULATOR

P.I. Blinov, G.I. Filgachev and D.N. Lin

Instruments And Experimental Techniques, Vol. 20, No. 2, pp 368-370 (04/1977)

Trans. From: Priroda i Tekhnika Eksperimenta 2, 35-37 (March-April 1977)

A diode consisting of a diode electron accelerator and an inductive accumulator in a beam collector circuit is described. When the anode-cathode gap is filled by the plasma or as a result of breakdown across the insulator, a potential difference is generated in the collector-anode gap which can be used to accelerate the electrons emitted by the collector. It is shown experimentally that with a voltage of 240 kV between the anode and cathode, the collector-anode voltage is 600 kV. The power of the beam is then doubled. 6 Refs.

Primary Keywords: Field Emission Diode; Plasma Diode Closure; Inductive Energy Store Switch; Beam Collector; Explosive Limiting Current Emission

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6678

(PULSE GENERATORS)

(Flux Compression)

LIMITING CURRENTS IN THE COMPRESSION OF MAGNETIC FLUX BETWEEN FLAT AND COAXIAL CONDUCTORS

E.I. Bichenkov and V.A. Lehanov

Novosibirsk, USSR

Journal Of Applied Mechanics And Technical Physics, Vol. 16, No. 5, pp 770-773 (10/1975)

Trans. From: Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki 5, 114-120 (September-October 1975)

Experiments are described on magnetic flux compression by flat and coaxial conductors. As the initial current 1/sub 0 is increased the final current 1/sub f obtained as a result of flux compression at first increases proportional to 1/sub 0 and then reaches a maximum and remains constant for further increases in 1/sub 0. Analysis of the experiments shows that in coaxial structures with a small explosive charge accelerates the conductors the limiting current is determined by the maximum work which a conductor can perform in compressing the magnetic field. In experiments with flat busbars and large explosive charges the limiting currents appear to be determined by the flux losses in short-circuited voids formed in the linking of irregular surfaces of the busbars. This assumption is shown to be in qualitative agreement with experiment. 3 Refs.

Primary Keywords: Flux Compression Generator; Flat Conductors; Coaxial Conductors; Limiting Current; Maximum Field Compression

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6681  
(PULSE GENERATORS)  
(Flux Compression)  
MAGNETIC FIELD IN A CYLINDRICAL CONDUCTOR MOVING WITH A VELOCITY PROPORTIONAL TO  $R/\sqrt{\mu}$   
E. I. Bichenkov and E. P. Matoschkin  
Novosibirsk, USSR  
Journal of Applied Mechanics and Technical Physics, Vol. 14, No. 5, pp 617-623 (10/1973)  
Trans. From: Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki 5, 18-23 (September-October 1973)

Nonstationary magnetic field problems in a moving conductor are of interest in connection with obtaining pulsed magnetic fields by magnetic cumulation. The field penetrates into the conductor as a result of the growth of the skin layer and is carried along with the conductor. The first mechanism of the interaction of a field with a conductor is called the diffusion of the field, and the second convection. Five self-similar solutions of magnetic field problems in a conductor which has a velocity  $v$  and a conductivity  $\sigma$  are obtained and discussed. A numerical solution of the problem of the compression of a field in a cylindrical cavity when the conductor moves toward the axis is presented. One of the self-similar solutions is compared with the numerical solution of Refs.  
Primary Keywords: Flux Compression; Field-conductor Interactions; Field Diffusion; Field Convection; Theory; Analytical Solution; Numerical Solution  
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6683  
(PULSE GENERATORS)  
(Flux Compression)  
METHOD OF DESIGNING EXPLOSIVE-DRIVEN MAGNETIC FIELD GENERATORS  
V. A. Lobanov  
Novosibirsk, USSR  
Journal of Applied Mechanics and Technical Physics, Vol. 17, No. 1, pp 97-102 (02/1976)  
Trans. From: Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki 1, 125-127 (January-February 1976)

A method of designing explosive-driven magnetic field generators that allows us to establish a dependence between the parameters of the generator circuit, in which the greatest energy release occurs under a time-invariant resistive load, is described. The problem of switching two-dimensional generators to a load whose resistance linearly increases with temperature is analytically solved as an example. The theoretical possibility of designing a generator in which the power released under the resistive load  $R(t)$  varies in a specified way with time is demonstrated. Types of current pulse, power, and energy released in the load are studied in the case of different generator circuit parameters. 8 Refs.  
Primary Keywords: Flux Compression Generators; Resistive Load; Time-invariant Load; Load Switching; Pulse Shaping; Circuit Parameter Variation  
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6685  
(ENERGY STORAGE, INDUCTIVE; POWER CONDITIONING)  
(Systems; Nonlinear Resistors)  
PRECISION PEAKING DISCHARGER WITH A NONLINEAR ELEMENT IN AN INDUCTIVE STORAGE CIRCUIT WITH FOIL BREAKER  
A. V. Grigor'ev, A. G. Novikov, V. V. Titkov and G. A. Shnereson  
Instruments and Experimental Techniques, Vol. 23, No. 5, pp 1193-1194 (10/1980)  
Trans. From: Pribury i Tekhnika Eksperimenta 5, 129-130 (September-October 1980)  
A solid-state peaking discharger for an inductive-capacitive energy store is described, in which the switch-on element is based on a Variv-2, which is a material with a nonlinear volt-ampere characteristic. The discharger has repeatedly switched currents with an amplitude of 360 kA and a duration of 80 microseconds. The self-inductance  $L_{sub p}$  of the discharger is 2.5 nH and its resistance  $r_{sub p}$  is 2.8 m ohm. 4 Refs.  
Primary Keywords: Nonlinear Resistor; Peaking Discharger; Inductive Energy Store; 2.5 nH Self-inductance; 260 kA Amplitude; Repetitive; 2 Microsecond Rise Time  
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6687  
(PARTICLE BEAMS, ION)  
(Generation)  
PULSED ION BEAMS FROM A HIGH-CURRENT PLASMA DIODE  
B. A. Tskhadaya, A. A. Plyusko and K. V. Sushakov  
Soviet Physics-Technical Physics, Vol. 19, No. 8, pp 1108-1109 (02/1975)  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 44, 1779-1781 (August 1974)  
In a study of pulsed ion beams in a high-current plasma diode it has been found that an ion beam of 6E2 A is produced when a critical diode current is reached and a discontinuity appears in the plasma. The ion beam has a large energy spread, but the average energy is approximately equal to the initial voltage,  $U_{sub 0}/\gamma = 30-50$  kV. The linear functional dependence of the ion beam current on the critical diode current implies that ion beams with currents of 2E4 A can be achieved at diode currents of 1E4 A. 8 Refs.  
Primary Keywords: Ion Beam Generation; Plasma-filled Diode; 30-50 kV Diode Voltage; 30-50 kV Ion Beam Energy; Threshold Current  
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6688  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
RESTORATION OF THE DIELECTRIC STRENGTH FOLLOWING EXPLOSION OF A WIRE  
R. K. Borisov, V. L. Budovich and I. I. Kuznetsov  
Moscow Energetics Institute, Moscow, USSR  
Soviet Technical Physics Letters, Vol. 1, No. 12, pp 516-517 (12/1977)  
Trans. From: Pis'ma Zhurnal Tekhnicheskoi Fiziki 3, 1250-1251 (December 1977)  
After an electrical explosion and the current cutoff, the insulating properties of the wire are known to be restored. An understanding of the process by which the dielectric strength is restored after an explosion can help in determining the state of the explosion products and the destruction mechanism of the wire. The rate at which the dielectric strength is restored is a characteristic which must be known in order to design switches, fast-acting fuses, etc. Although there are many papers on electrical explosions in the literature, no information is available on the restoration of dielectric strength after the explosion of a wire. Furthermore, there is no information on the restoration of the dielectric strength after the explosion of wires in air and quartz sand. 5 Refs.  
Primary Keywords: Exploding Wires; Recovery; Wire Restoration; Air Environment; Sand Environment; Copper Wire  
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6689  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
SCREENING EFFECT IN HIGH-CURRENT DIODES  
S. Ya. Belomytsev, S. D. Korovin and G. A. Mesyats  
Academy of Sciences of the USSR, Tomsk, USSR  
Soviet Physics-Technical Physics Letters, Vol. 6, No. 9, pp 466-467 (09/1980)  
Trans. From: Pis'ma Zhurnal Tekhnicheskoi Fiziki 6, 1089-1092 (September 1980)

Secondary processes which occur in high-current diodes with explosive electron emission lead to the appearance of new emission centers through propagation of the cathode plasma. We have found that there is an opposite effect, which opposes the spontaneous appearance of new centers of explosive electron emission. We have shown that a screening effect is responsible for this situation. The occurrence of explosive electron emission leads to a pronounced increase in the electron current. The space charge of these electrons reduces the electric field at the cathode near the primary emission center. The time at which explosive emission occurs,  $t_e$ , is proportional to  $1/\sqrt{J_{sub 0}}$ , where  $J_{sub 0}$  is the field-emission current, which is an exponential function of the electric field. Consequently, even a slight decrease in the electric field of the cathode prevents the spontaneous appearance of new emission centers. This effect leads to an inhomogeneity of the electron beam in an explosive-emission diode, and in several cases, e.g., that of the low-energy beams used for surface phenomena, it becomes difficult or even impossible to use these beams. 2 Refs.  
Primary Keywords: Electron Generation; Field Emission Diode; Explosive Emission; Multitip Cathode; Screening Effect; Beam Inhomogeneity  
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6690  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
SELF-MAINTAINED ELECTRICAL SKIN EXPLOSION OF A CONDUCTOR  
E. I. Bichenkov and A. E. Votenko  
Novosibirsk, USSR  
Journal of Applied Mechanics and Technical Physics, Vol. 10, No. 3, pp 352-355 (06/1969)  
Trans. From: Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki 10, 215-218 (May-June 1969)

We examine the problem of the electrical explosion of a conductor with flat boundary in a strong magnetic field. We estimate the role of heat conduction in order to determine the critical electrical fields in which fusion and vaporization of the metal take place. The characteristic features of the explosion of a layered medium are examined. 4 Refs.  
Primary Keywords: Flat Wire; Wire Skin Explosion; Magnetic Field; Thermal Conduction; Layered Wire  
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6691  
(BREAKDOWN STUDIES)  
(Gas; E-beam)  
SEMISELF-MAINTAINED DISCHARGE DEVICE WITH IONIZING BEAM REGENERATION  
L. P. Foriniski  
Novomoskovsk, Branch Of State Nitrogen Industry Institute, USSR  
Instruments and Experimental Techniques, Vol. 20, No. 1, pp 213-215 (02/1977)  
Trans. From: Pribury i Tekhnika Eksperimenta 1, 186-188 (January-February 1977)  
A device for generating a semiself-maintained discharge in a gas, initiated by an electron beam from an accelerator, in which the electron beam is regenerated is described. With this device it is possible to achieve an electrical field strength in the base of  $\approx 100$  kV/cm without a transition into a spark discharge. 6 Refs.  
Primary Keywords: Semiself-maintained Discharge; E-beam Sustained Discharge; Retarded E-beam; Very High Field Strength; No Spark Transition  
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6692  
(BREAKDOWN STUDIES)  
(Liquid; Electrical)  
EFFECT OF DECOMPOSITION OF ELECTRICAL DISCHARGE IN WATER  
A. P. Akhmedov, V. Z. Vorobiev, V. F. Klimkin, A. G. Ponomarenko and R. I. Solov'ev  
The Institute of Nuclear Physics, Siberian Branch, Academy of Sciences of the USSR, Novosibirsk, USSR  
Soviet Physics-Technical Physics, Vol. 19, No. 10, pp 959-961 (04/1971)  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 41, 1052-1054 (October 1970)  
Distilled water is used in high-voltage impulse energy storage and pulse modulators and it is, therefore, necessary to make a thorough study of the physical features of the development of electrical discharge in water at field strengths of 100 to 500 kV/cm. In addition to clarifying certain fundamental problems of the physics of breakdown of water under these conditions it is of particular interest to obtain quantitative characteristics of the process, such as the delay time  $t_{sub d}$ , the streamer velocity  $v_{sub s}$  and its dependence on the field strength  $E_{sub 0}$ , the resistivity  $\rho$ , pressure  $p$ , etc. 2 Refs.  
Primary Keywords: Water Breakdown; Distilled Water; Insulation; Switch; Shodography; Voltage Measurement; Delay Measurement; Streamer Velocity Measurement  
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6693  
(ENERGY STORAGE, INDUCTIVE)  
(Systems)  
TRANSIENTS IN INDUCTIVE ENERGY-STORE DEVICES FOR PLASMA INJECTORS  
N. V. Belov, N. A. Mashtylev and B. I. Panachev  
Kharkov Aviation Institute, USSR  
Soviet Physics-Technical Physics, Vol. 18, No. 1, pp 51-53 (07/1973)  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 43, 83-85 (January 1973)  
The present work considers charging and discharging processes in an inductive energy-storage device for a pulsed plasma injector. A system of equations is given which describe the transient that arises in an inductive storage device when the charging circuit is switched by the moving flame. The system is solved analytically for one particular case. An experiment involving transients in an inductive energy-storage device is described. The results of the experiments are in satisfactory agreement with the analytic solution of the system of equations. 8 Refs.  
Primary Keywords: Charging Process; Discharge Process; Plasma Switch; Experiment; Theory; Analytical Solution  
Secondary Keywords: Plasma Injector  
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6694  
(BIFURCATION STUDIES)  
(Cos. E-beam)  
TRANSITION FROM A NON-SELF-SUSTAINED VOLUME DISCHARGE MAINTAINED BY A BEAM OF FAST ELECTRONS TO A SPARK DISCHARGE  
Yu. I. Ryckov, S. A. Gorkin, Yu. D. Korolev, S. A. Menyay, V. G. Rabotkin and A. G. Filonov  
Institute of High Current Electronics, Academy of Sciences of the USSR, Moscow, USSR  
Soviet Physics Journal, Vol. 21, No. 10, pp 1375-1377 (10/1978).  
Trans. from Izvestiya Vysshikh Uchebnykh Zavedeniy, Fizika 21, 146-148 (October 1978).

Non-self-sustained current regimes are an efficient way of obtaining volume discharges with considerably wider ranges of gas pressure and burn duration. By applying lower voltages than the breakdown voltage to the discharge gap, it is possible to obtain a stable volume discharge maintained by a beam of fast electrons and lasting approximately 10-4 sec or longer. However, in this regime the amount of energy which can be fed to the discharge is also limited by formation of a spark channel. In this paper we report observations of the dynamics of the formation of a spark channel in a volume discharge excited by an electron beam. The discharge was in nitrogen at atmospheric pressure. The interelectrode gap was 6 cm long and was formed by a 8.5-cm-diameter Duraluminum anode and a convex steel mesh with a grid size of 2 x 2 mm. Electrons were injected from the cathode end through a 4 x 4 cm window. An accelerator with a plasma electron source similar to that described previously was used. The electron current pulse was triangular with a fast rise time (1/2 sub  $\mu$ sec) and a slow decay (the half maximum duration of the current was 150 microseconds). The peak current density of the beam at the entrance to the gap discharge gap was 50 sub  $\mu$ sec, 0.3 A/cm<sup>2</sup> and the accelerating voltage was 230-250 kV. 9 Refs.

Primary Keywords: Non-self-sustained Discharge; Volume Discharge; E-beam Sustained Discharge; Arc Transition; Nitrogen Gas; Laser Current Pulse  
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6695  
(PULSE GENERATORS; POWER CONDITIONING)  
(Flux Compression; Pulse Transformers)  
USE OF AN EXPLOSIVE MAGNETIC GENERATOR TO SUPPLY A GAS DISCHARGE  
A. E. Vaitenko, I. P. Matveichuk and V. A. Yabluchikov  
Institute of Nuclear Physics, Academy of Sciences of the USSR, Novosibirsk, USSR  
Instruments And Experimental Techniques, Vol. 16, No. 3, pp 866-867 (06/1973).  
Trans. from Pribury i Tekhnika Eksperimenta 3, 177-178 (May-June 1973).  
A device is described which consists of an explosive magnetic generator acting as a current source, a matching transformer, and a resistive load. A gas discharge was used as the load. The experiments were carried out under laboratory conditions. 9 Refs.  
Primary Keywords: Explosive Magnetic Generator; Matching Transformer; Gas Discharge; 50 Microsecond Generator Operating Time; Pulsed Electric Light Source  
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6698  
(SWITCHES; CLOSING)  
(Cos Geos. Materials)  
A THEORY OF THE PRODUCTION OF ELECTRODE VAPOR JETS BY SPARKS AND ARCS  
W. Finkelburg  
Engineer Research and Development Lab, Fort Belvoir, VA  
Physical Review, Vol. 75, No. 10, pp 1475-1477 (11/1948).  
Ionization of the surfaces of mercury and carbon electrodes and the subsequent production of vapor jets are discussed. The theory presented is found to agree closely with the experimental values for the vapor jet velocity. On the other hand, theoretical predictions are made for vapor jet production based on the atomic properties of the electrode material. 6 Refs.  
Primary Keywords: Vapor Jet; Anode Jet; Cathode Jet; Mercury Arc; Thermal Considerations  
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6701  
(ELECTROMAGNETIC FIELD GENERATION)  
(Magnetic)  
AN EXPLOSIVE-DRIVEN HIGH-FIELD SYSTEM FOR PHYSICS APPLICATIONS  
P. S. Caird, W. B. Gern, D. B. Thompson and C. H. Fowler  
Los Alamos National Labs, Los Alamos, NM 87545  
Journal of Applied Physics, Vol. 35, No. 3, pp 781-782 (03/1964).  
A simple explosive driven flux compression system is described for producing magnetic fields in the MG range. The flux trapping device is a seamless hollow stainless steel cylinder driven by a ring of explosive. The initial field is produced by a coil pair supplied by a 90 kJ capacitor bank. The explosive pressure is accounted for during implosion; the experimental volume is free of noticeable debris and asymmetries. Peak fields of 1.2 and 4 MG are achieved in working diameters of 8.9 and 3.2 mm, respectively. The usable length is about 15 mm at these fields. Several possible applications are mentioned. 2 Refs.  
Primary Keywords: Magnetic Field Generation; Flux Compression; Explosive Driven; Stainless Steel Cylinders; 4 MG Field  
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6704  
(ELECTROMAGNETIC FIELD GENERATION)  
(Magnetic)  
ANALYSIS OF FLUX COMPRESSION EXPERIMENTS III  
T. Erber (1), H. G. Jatal (2), J. E. Kennedy (2) and S. M. Prastin (3)  
(1) Institut für Theoretische Physik, Universität Graz  
(2) Illinois Institute of Technology, Chicago, IL  
(3) Argonne National Lab, Argonne, IL  
Acta Physica Austriaca Vol. 34, No. 4, pp 314-315 (01/1972).  
This is the third of a series of three papers on magnetocompression. The authors present a complete analysis of their flux compression experiments from the theory of flux compression to analysis of data. General specific devices are presented. 24 Refs.  
Primary Keywords: Flux Compression; Theory; Top-Notch Stages Of Flux Compression; Experiments; Theory  
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6715  
ENERGY AND TECHNOLOGY REVIEW  
Lawrence Livermore Lab, Livermore, CA 94550  
(05/1981)  
Availability: UCRL-52000-81-5  
NTIS  
Research programs at LLNL are reviewed. This issue discusses validation of the pulsed-power design for FFR, the NOVA plasma shutter, thermal control of the MTF superconducting magnet, a low-energy x-ray spectrometer for pulsed-source diagnostics, microchanneling, the electronics engineer's design station, and brazing with a laser microtorch. (ERA citation 08:028019)  
Primary Keywords: Lawrence Livermore Laboratory; Cooling Systems; Electrical Engineering; High-voltage Pulse Generators; Machining; Optical Systems; Research Programs; Shuttles; Superconducting Magnets; X-ray Spectrometry  
Secondary Keywords: ERDA/420300; ERDA/420800; ERDA/420201; NTISDE

6726  
(DIAGNOSTICS AND INSTRUMENTATION; SWITCHES; CLOSING)  
(Systems; Cos Geos. Materials)  
A SIMPLE DEVICE FOR SIMULTANEOUS MEASUREMENT OF BREAKDOWN TIMES OF MANY SPARK GAPS  
G. Postegni  
Padova University, Padova, Italy  
The Review of Scientific Instruments, Vol. 37, No. 1, pp 65-68 (01/1966).  
A simple device, which enables one to observe on a single oscilloscope trace the individual breakdown times of many spark gaps in parallel, is described. It employs signals from magnetic probes placed near each spark gap. For illustration, the signals of typical breakdown conditions are shown and briefly discussed on the basis of some qualitative remarks on the behavior of a fast discharge capacitor bank. 6 Refs.  
Primary Keywords: Magnetic Probe; Addition Of Several Signals; Spark Gap Monitoring; Parallel Spark Gap Operation  
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6733  
(PULSE GENERATORS; POWER CONDITIONING)  
(Capacitor Banks; Pulse Transformers)  
HIGH VOLTAGE IMPULSE SYSTEM  
D. Finkelstein, P. Goldberg and J. Shuchatowitz  
Yeshiva University of New York, NY 10033  
The Review of Scientific Instruments, Vol. 37, No. 2, pp 159-162 (02/1966).  
An alternative to the Marx circuit for the production of high voltage, high current pulses is developed. It employs a water-immersed spiral-wound stepup transformer to go from a capacitor bank charged to 100 kV to an output of 1 MV. A method for using such a transformer to pulse charge a second capacitor bank efficiently without very tight coupling is derived. It is shown that for total transfer of energy (except for dissipation) the two resonant frequencies of the primary and secondary LC circuits (each measured with the other circuit open) should be equal, while the two normal mode frequencies of the coupled circuit should be in the ratio of 2:1, implying a coupling coefficient of 3/5. The design and operation of such a system is described. 3 Refs.  
Primary Keywords: Pulse Generator; Capacitor Bank; Spiral Wound Transformer; Resonant Pulse Charging; 2-1 Transformer Ratio  
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6741  
(ELECTROMAGNETIC FIELD GENERATION)  
(Magnetic)  
MAGNETIC FLUX COMPRESSION BY MAGNETICALLY IMPLoded METALLIC FOILS  
E. C. Ghore  
Sandia Labs, Albuquerque, NM 87115  
Journal of Applied Physics, Vol. 37, No. 10, pp 3812-3816 (09/1966).  
A 116-kJ capacitor-bank energy source was used to implode metallic foils in a "theta" pinch. Aluminum foils accelerated by this scheme attained a velocity of 2.3 mm/microsecond and a capacitive-to-kinetic energy conversion efficiency of 23%. An upper limit for the foil velocity depended upon the foil thickness and density, together with a parameter which accounted for electrical heating of the foil. This parameter was determined in exploding wire studies. Experiments with and without auxiliary injection of magnetic flux are described. Thick, imploding foils have been found to be capable of compressing imploding magnetic flux to more than 2 MG. 9 Refs.  
Primary Keywords: Imploded Metallic Foils; 136 kJ Capacitor-Bank Energy Source; 2.3 mm/microsecond Aluminum Foil Velocity; Megagauss Magnetic Fields; Theta-pinch Arrangement; 2 MG Magnetic Flux Compression; Semiempirical Mathematical Model  
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6747  
(ELECTROMAGNETIC FIELD GENERATION)  
(Magnetic)  
MEGAGAUSS PHYSICS  
C. H. Fowler  
Los Alamos National Labs, Los Alamos, NM 87545  
Science, Vol. 180, pp 261-267 (04/1973).  
The generation and application of megagauss magnetic fields is the subject of this paper. Field generation by capacitor discharge and flux compression are considered briefly with the main thrust concentrated on applications. Several experiments are described briefly, which require the use of high magnetic fields. 51 Refs.  
Primary Keywords: Magnetic Field Generation; Solenoids; Flux Compression; Application; High Pressure Physics; Particle Physics  
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6749  
(PULSE GENERATORS; SWITCHES; CLOSING; SWITCHES; OPENING)  
(Systems; Solid Dielectric; Electrical; Explosive Fuses)  
METHOD OF PRODUCING A FAST CURRENT RISE FROM ENERGY STORAGE CAPACITORS  
H. G. Erber and F. J. Martin  
University of Michigan, Ann Arbor, MI  
The Review of Scientific Instruments, Vol. 36, No. 7, pp 1000-1002 (07/1965).  
A rate of current rise of the order of 1E12 A/sec can be produced by inductive capacitors used in conjunction with a special, low inductance fuse and spark gap. The capacitors are discharged through the fuse until the current reaches a near maximum value at which time the current is transferred from the fuse into a load inductance of about 1 pF. The spark gap isolates the load until the moment of current transfer. 3 Refs.  
Primary Keywords: Capacitor Bank; Solid Dielectric Switch; Melting Fuse; Inductance; Low Inductance Independent  
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6759  
(ELECTROMAGNETIC FIELD GENERATION)  
(Magnetic)  
PRODUCTION OF VERY HIGH MAGNETIC FIELDS BY IMPLSION  
C.M. Fowler, W.B. Garn and R.S. Caird  
Los Alamos National Labs, Los Alamos, NM 87545  
Journal Of Applied Physics, Vol. 31, No. 3, pp 588-594 (03/1960).  
Magnetic fields are produced in the 10-15 megagauss range by use  
of high explosives which compress the flux obtained from initial  
fields of approximately a hundred thousand gauss. The fields  
described here occupy a cylindrical volume and are essentially axial.  
A typical field might have these general characteristics: Peak field  
16 megagauss; 2 microsecond duration from 10-16 megagauss; field  
volume around peak, 6 mm diameter, 50 mm estimated length. 4 Refs.  
Primary Keywords: Magnetic Field Generation; Flux Compression;  
Explosive Driver; 16 MG Field; 100 KG Pump Field  
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6772  
(INSULATION, MATERIAL; BREAKDOWN STUDIES)  
(Liquid; Liquid; Electrical)  
COMPARISON OF THE DIELECTRIC PROPERTIES OF NORMAL AND HEAVY WATER,  
ABSORBED ON ZEOLITES  
B.A. Glazun, M.M. Dubinin and I.V. Zhilenkov  
Voronezh Agricultural Institute And Institute Of Physical Chemistry,  
Academy of Sciences of the USSR  
Bulletin Of The Academy Of Sciences, USSR, Division Of Chemical Science,  
No. 5, pp 956-959 (05/1967).  
Trans. From: Izvestiya Akademii Nauk SSSR, Seriya Khimicheskaya 5,  
987-990 (May 1967)  
A study of the dielectric properties indicated that the relaxation  
times of heavy water and heavy ice are greater than those of normal  
water and ice. We have found that in hydrated NaA zeolite there are  
two relaxation processes (which we denoted at I and II), caused by  
the presence of water. A study by the dielectric method revealed that  
the relaxation times of the adsorbed water are intermediate between  
the relaxation times of liquid water and ice. It is therefore natural  
to expect that the relaxation maximum caused by adsorbed water will  
be displaced toward lower frequencies, if normal water is replaced by  
heavy water. 19 Refs.  
Primary Keywords: Water; Heavy Water; Hydrated Zeolite; Conductivity  
Measurement; Relaxation  
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6789  
(PULSE GENERATORS)  
(Line Type)  
A GENERATOR OF CURRENT PULSES OF ADJUSTABLE SHAPE AND DURATION FOR  
SUPPLYING GAS-DISCHARGE TUBES  
S.A. Vitsinskii, V.I. Kulakov and V.M. Oppe  
Instruments And Experimental Techniques, Vol. 23, No. 1, pp 121-123  
(02/1980).  
Trans. From: Pribury i Tekhnika Eksperimenta 1, 123-124  
(January-February 1980)  
A generator of current pulses of adjustable shape and duration,  
built on the basis of an artificial long line with ignition  
dischargers in sections of the line, is described. The generator  
allows one to obtain current pulses of different shapes and an  
amplitude of up to 10 kA in a gas-discharge load. Discrete regulation  
of the duration of the current pulse from 300 to 600 microseconds  
with an interval of 100 microseconds is possible. 5 Refs.  
Primary Keywords: Pulse Generator; Artificial Long Line; Variable  
Pulse Shape; 10 kA Output Current; 300-600  
Microsecond Pulse Duration  
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6790  
(POWER CONDITIONING)  
(Pulse Transformer)  
A HIGH-VOLTAGE CABLE TRANSFORMER FOR PRODUCING STRONG PULSED CURRENTS  
V.G. Gaeze and G.A. Shnereson  
Instruments And Experimental Techniques, No. 6, pp 1413-1418 (12/1965).  
Trans. From: Pribury i Tekhnika Eksperimenta 6, 105-110  
(November-December 1965)  
The basic calculation principles are discussed and designs  
described for step-down cable transformers with a primary voltage of  
up to 150 kV for producing current pulses of up to 3 MA. 5 Refs.  
Primary Keywords: Step-down Cable Transformers; 150 kV Primary  
Voltage; 3 MA Current Pulses; High-voltage Coaxial  
Cable; Leakage Inductance Reduced; Insulation  
Problem Solved  
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6793  
(ENERGY STORAGE, MECHANICAL)  
(Rotating Machines)  
ACYCLIC GENERATORS WITHOUT A FERROMAGNETIC MAGNETIC CIRCUIT FOR  
SUPPLYING ELECTROPHYSICAL APPARATUS USED IN MHD RESEARCH  
B.L. Alievskii, A.J. Bertinov and A.G. Shorstuyuk  
Magneto-hydrodynamics, Vol. 3, No. 1, pp 87-91 (12/1967).  
Trans. From: Magnitnaya Gidrodinamika 3, 135-142 (1967)  
The authors discuss a method of calculating generator  
electromagnetic characteristics that utilizes the idea of the mutual  
inductance of annular field coils of finite cross section and a  
cylindrical or disk armature. 11 Refs.  
Primary Keywords: Acyclic Generators; Generator Electromagnetic  
Characteristic Calculation; Annular Field Coils;  
Liquid-metal Current Collector; Strong Magnetic  
Fields; Equivalent Loop Method  
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6799  
(ENERGY STORAGE, CAPACITIVE)  
(Capacitor Banks)  
CAPACITOR BATTERY FOR ONE MEGAJOULE HAVING A SMALL TIME CONSTANT  
V.A. Burtshev, V.N. Litunovskii, V.F. Prokhorov and G.M. Makeyev  
Instruments And Experimental Techniques, Vol. 22, No. 4, pp 1056-1059  
(08/1979).  
Trans. From: Pribury i Tekhnika Eksperimenta 4, 167-170 (July-August  
1979)  
A capacitor battery for one megajoule is described which is made  
up with type IM-50/3 capacitors in a modular arrangement. The battery  
parameters are: Capacity 854 microfarads, self-inductance 4 nH,  
natural period 12 microseconds, and short-circuit current 24 MA. 6  
Refs.  
Primary Keywords: Capacitor Bank; 1.1 MJ Energy Storage; 24 MA Output  
Current; 4 nH Inductance; Modular Construction;  
Solid Dielectric Switch  
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6800  
(ENERGY STORAGE, INDUCTIVE; PULSE GENERATORS)  
(Systems; Flux Compression)  
CHARGING OF AN INDUCTIVE ACCUMULATOR FROM AN EXPLOSIVE-TYPE MAGNETIC  
GENERATOR THROUGH AN ELECTRICAL EXPLOSIVE-TYPE CURRENT BREAKER  
L.S. Gerasimov, V.I. Ikryannikov and A.I. Pinchuk  
Novosibirsk, USSR  
Journal Of Applied Mechanics And Technical Physics, Vol. 15, No. 5, pp  
693-697 (10/1974).  
Trans. From: Zhurnal Prikladnoi Tekhnicheskoi Fiziki 15, 132-137  
(September-October 1974)  
Analytical investigations were made of electromagnetic processes  
with the work of an explosive-type magnetic generator, in a  
series-connected inductive-type accumulator and a current breaker  
based on an exploding wire. A solution is obtained in dimensionless  
form for a model of a current breaker based on an ohmic resistance,  
whose value rises linearly with the temperature. The conditions are  
determined under which an inductive load can be connected in parallel  
to the current breaker; under those circumstances, the current of the  
load branch remains small during the whole charging stage. 6 Refs.  
Primary Keywords: Inductive Accumulator; Explosive-type Magnetic  
Generator; Electromagnetic Processes; Current  
Breaker; Ohmic Resistance  
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6815  
(BREAKDOWN STUDIES)  
(Exploding Foil)  
ELECTRICAL CONDUCTIVITY OF AN ALUMINUM FOIL IN AN ELECTRICAL EXPLOSION  
A.P. Baikov, L.S. Gerasimov and A.M. Iskol'dskii  
Institute Of Automation And Electrometry, Academy of Sciences of the  
USSR, Novosibirsk, USSR  
Soviet Physics-Technical Physics, Vol. 20, No. 1, pp 29-32 (07/1975).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 45, 49-55 (January 1975)  
In a study of the electrical conductivity of aluminum foil as  
energy is rapidly supplied to it during an electrical explosion, it  
has been established that the function dependence of the foil  
resistance on the specific energy changes with the energy supply  
rate. This behavior had been observed in an earlier study of  
exploding wires. The present experimental results are in accord with  
the model of surface evaporation waves. A possible physical mechanism  
for the electrical explosion of foil is offered. 10 Refs.  
Primary Keywords: Electrical Conductivity; Foil Resistance; Electrical  
Explosion Of Foils; Surface Evaporation Wave Model  
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6817  
(ENERGY STORAGE, INDUCTIVE; SWITCHES, OPENING)  
(Systems; Explosive Fuses)  
ENERGY TRANSFER FROM AN INDUCTIVE STORAGE BY MEANS OF AN EXPLOSIVE  
CURRENT DISCONNECT  
L.S. Gerasimov, A.M. Iskol'dskii, Yu.E. Mesterikhin and V.K. Pinus  
Novosibirsk, USSR  
Journal Of Applied Mechanics And Technical Physics, Vol. 16, No. 1, pp  
47-51 (02/1975).  
Trans. From: Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki 1,  
66-69 (January-February 1975)  
Energy transfer from an inductive storage is considered for two  
types of systems: a disconnect with an intrinsic parasitic inductance  
for an inductive load and a purely resistive disconnect for a  
resistive load. Solutions are obtained for the voltage, power, and  
energy transferred from the load. The dependence of the efficiency of  
the device on its parameters is established. 4 Refs.  
Primary Keywords: Inductive Storage; Explosive Current Disconnect;  
Energy Transfer; Efficiency Dependence On  
Parameters; Parasitic Inductance; Theory  
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6819  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
EXPLODING WIRES WITH HIGH ENERGY INPUT  
A.P. Baikov, A.M. Iskol'dskii and Yu.E. Mesterikhin  
Institute Of Automation And Electrical Measurements, Academy of  
Sciences of the USSR, Novosibirsk, USSR  
Soviet Physics-Technical Physics, Vol. 18, No. 1, pp 87-89 (07/1973).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 43, 136-140 (January 1973)  
The explosion of tungsten wires has been observed with an  
oscilloscope and by synchronous photography at energy input rates of  
dw/dt approximately  $10^{10} - 10^{11}$  J/g sec. When  $dw/dt > 10^{10}$  J/g sec,  
the electrical explosion (for a diameter of 1E-3 cm) occurs without  
magnetohydrodynamic instabilities. It is found that the resistance  
near the pinch point is reduced when the energy input rate is  
increased. A criterion is derived for this effect. 5 Refs.  
Primary Keywords: Electrically Exploded Tungsten Wires;  $10^{10} - 10^{11}$   
J/g Energy Input Rates; Magnetohydrodynamic  
Instabilities; Phase-transition Point Resistance  
Reduced; Theory  
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6826  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
HIGH-CURRENT ELECTRON ACCELERATOR FOR OPTICAL PUMPING OF GASES  
G.R. Bercalyants, V.A. Mamikonyan, G.I. Nersisyan and V.O. Papanyan  
Institute Of Physical Studies, Academy of Sciences of the Armenian SSR,  
Ashtarak, USSR  
Soviet Technical Physics Letters, Vol. 4, No. 11, pp 543-544 (11/1978).  
Trans. From: Pis'ma Zhurnal Tekhnicheskoi Fiziki 4, 1349-1351  
(November 1978)  
Recent years have seen progress in the use of high-current  
electron beams to produce high-pressure gas lasers for the UV and  
vacuum-UV ranges. A high-current source of square electron pulses  
developed for this purpose has an electron energy which can be varied  
over the range 0.3-0.7 MeV, a pulse length of 30 nsec, and a current  
density (in the high-pressure laser chamber) of 40-100 A/sq.cm. This  
electron accelerator uses a rectangular cold cathode with an  
independent discharge over the surface of a dielectric with a high  
value of erosion. Experiments have been carried out with cathodes of  
stainless steel, copper, and graphite. 7 Refs.  
Primary Keywords: Electron Generation; Field Emission Diode; Several  
Cathode Materials; 700 keV Beam Energy; 100 A/sq.Cm.  
Current Density  
Secondary Keywords: Gas Laser Pumping  
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## 6830

## (BREAKDOWN STUDIES)

## (Exploding Wires)

## INITIAL STAGES OF THE ELECTRICAL EXPLOSION OF A WIRE IN AN LC-LOOP

L.S. Gerasimov, A.I. Pinchuk and Yu.A. Stukalin  
Novosibirsk, USSR  
Journal Of Applied Mechanics And Technical Physics, Vol. 19, No. 6, pp 721-727 (12/1978)  
Trans. From: Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki 6, 18-25 (November-December 1978)

A great amount of work has been devoted to the investigation of the phenomenon of the electrical explosion of a wire, and several models have been proposed to explain its physical mechanism. The fact that there is no single generally accepted point of view indicates that with respect to the phenomenon of the electrical explosion of a wire, all is not yet clear. However, it cannot be disputed that the essence of the phenomenon of the electrical explosion of a wire is competition between the processes: the breakdown of the wire as a whole and the accompanying loss of electrical conductivity, on the one hand, and the evolution of Joule heat, on the other hand. Here the mechanism of the breakdown itself is determined by the rate of introduction of energy. From what has been said it is clear that the moment of an electrical explosion and its physical mechanism are determined by the rate of introduction of energy. A change was observed on a previous article in the character of an electrical explosion as a function of the rate of heating of the liquid phase. The present article poses the problem of the determination of this rate from the initial conditions of the experiments. 16 Refs.

Primary Keywords: Electrical Explosion; Wire Breakdown; Electrical Conductivity Loss; Joule Heat; Evolution; Heating Model; Introduction Rate; Quasi-steady-state Heating Model; Theory

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## 6832

## (BREAKDOWN STUDIES)

## (Liquid, Electric)

## INVESTIGATING PREBREAKDOWN FIELDS IN WATER BY MEANS OF THE KERR EFFECT

I.T. Ovchinnikov, K.V. Yanshin and E.V. Yanshin  
Institute Of Automation And Electrometry, Academy of Sciences of the USSR, Novosibirsk, USSR  
Soviet Physics Technical Physics, Vol. 19, No. 2, pp 294-295 (08/1974)  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 44, 472-474 (February 1974)

The electric field distribution in the gap for a extended electrodes is investigated in fields of 1.3 MV/cm. Space charge, which can distort the field in the gap, is not formed for 200 nsec (measurement error of 0.3%). 5 Refs.

Primary Keywords: Prebreakdown Field Investigation; Kerr Effect; 1.3 MV/cm Fields; Space Charge; Electric Field Distribution; Polarity Effect

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## 6834

## (ENERGY STORAGE, CAPACITIVE)

## (Capacitor Banks)

## LOW-INDUCTANCE CAPACITOR MODULE FOR CHARGING TO 100 KV AND ENERGY STORAGE CAPACITY 80 KJ

A.B. Andreev, V.A. Burtsev, V.M. Vodovozov, A.A. Drozdov and G.M. Makeev  
Instruments And Experimental Techniques, Vol. 23, No. 2, pp 407-410 (04/1980)  
Trans. From: Pribury i Tekhnika Eksperimenta 2, 109-112 (March-April 1980)

The construction is described of a capacitor module which charges to 100 kV and is equipped with two dischargers with a solid dielectric, a system for triggering the dischargers with insulation from the control circuits effective to 100 kV DC, and a system for guarding and automatically charging the capacitors. The proper period of discharging of the module is  $\tau_{\text{sub}} = 5.6$  microseconds. The capacitor module was used in experiments studying electrical explosion of flat Al foils in pulverized quartz. An overvoltage  $U_{\text{sub max}}$  divided by  $I_{\text{sub}}$  of approximately 10 was obtained at a maximal electric field intensity  $E_{\text{sub max}}$  of approximately 12 kV/cm. 3 Refs.

Primary Keywords: Capacitor Bank; Modular Construction; Solid Dielectric Switch; 100 KV Output Voltage; Exploding Foil; Quartz Environment

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## 6835

## (PULSE GENERATORS)

## ( Marx )

## LOW-INDUCTANCE GENERATOR OF PULSED VOLTAGE AT 1 MV

G.I. Koba, Yu.V. Koba, I.M. Slivkov, A.M. Sukhov and E.Z. Tarumov  
Instruments And Experimental Techniques, Vol. 23, No. 1, pp 115-119 (02/1980)  
Trans. From: Pribury i Tekhnika Eksperimenta 1, 117-120 (January-February 1980)

A high-voltage generator of pulsed voltage, built on the Arkad'ev-Mark scheme, for a voltage of 1 MV and an energy of 12 kJ with a discharge circuit inductance of 1.3 microhenry is described. The low inductance of the generator is obtained through the use of low-inductance capacitors and a system of double-wound leads. A firing system with resistive coupling between stages of the generator, based on controllable three-electrode dischargers with field distortion, was developed for reliable triggering of the generator. 5 Refs.

Primary Keywords: Marx Generator; Low Inductance Circuit; Double-wound Interconnections; Field Distortion Spark Gap; All Stages Triggered

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## 6836

## (SWITCHES, CLOSING)

## (Gas Gaps, Electric)

## LOW-PRESSURE GAS-DISCHARGE COMMUTATORS

I.I. Aksenov and S.A. Smirnov  
Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Kharkov, USSR  
Instruments And Experimental Techniques, Vol. 15, No. 3, pp 945-946 (06/1972)

The paper presents the results of investigating a sealed gas-spark gap device with a cold cathode for commutating powerful current pulses. Tests for service life were made on the device proposed by the authors, which had a hollow cathode and was controlled by a pulse glow discharge, and on a vacuum spark gap having several versions of a trigger starting device. 3 Refs.

Primary Keywords: Sealed Gas-spark Gap Device; Low Pressure; Hollow Cathode; Cold Cathode; Strong Electrode Emission; High Current Switching; High Voltage Discharge

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## 6837

## (ELECTROMAGNETIC FIELD GENERATION; PULSE GENERATORS)

## (Magnetic; Flux Compression)

## MAGNETIC ACCUMULATION IN A PLANE LINER OF FINITE THICKNESS

L.S. Gerasimov and V.I. Ikryennikov  
Institute Of Automation And Electrometry, Academy of Sciences of the USSR, Novosibirsk, USSR  
Soviet Physics Technical Physics, Vol. 23, No. 2, pp 147-149 (02/1978)  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 48, 244-248 (February 1978)

The diffusion loss of magnetic flux in magnetic accumulation in a plane, uniform liner of finite thickness is studied. This loss is shown to depend on the degree of compression, the nature of the pump, and two magnetic Reynolds numbers. When the liner is thin the flux loss is independent of the nature of the pump, being governed only by a single Reynolds number. An equivalent circuit for the system is proposed. 7 Refs.

Primary Keywords: Flux Compression; Magnetic Flux Loss; Magnetic Accumulation; Plane, Uniform Liner; Magnetic Reynolds Number; Theory

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## 6838

## (PULSE GENERATORS)

## (Flux Compression)

## MAGNETIC ACCUMULATION IN A TAILORED-PROFILE, PLANE, EXPLOSIVE-MAGNETIC GENERATOR WITH ARBITRARY LOAD

L.S. Gerasimov and V.I. Ikryennikov  
Institute Of Automation And Electrometry, Academy of Sciences of the USSR, Novosibirsk, USSR  
Soviet Physics Technical Physics, Vol. 23, No. 7, pp 859-861 (07/1978)  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 48, 1520-1524 (July 1978)

The diffusive loss of magnetic flux is studied in magnetic accumulation in a tailored-profile, plane, explosive-magnetic generator with an arbitrary load. A method for constructing the equivalent circuit of the device is studied for the inductive and resistive loads. Flux diffusion is taken into account. The profile is optimized for the inductive load. The profile need not be corrected for diffusion with a resistive load. 5 Refs.

Primary Keywords: Flux Compression; Optimum Profile; Arbitrary Load; Diffuse Magnetic Flux Loss; Magnetic Accumulation; Tailored-profile Explosive-magnetic Generator

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## 6839

## (PULSE GENERATORS; POWER CONDITIONING)

## (Flux Compression; Pulse Transformers)

## MATCHING AN EXPLOSIVE-MAGNETIC GENERATOR TO A RESISTIVE LOAD USING A TRANSFORMER

L.S. Gerasimov  
Novosibirsk, USSR  
Journal Of Applied Mechanics And Technical Physics, Vol. 19, No. 4, pp 460-463 (08/1978)  
Trans. From: Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki 4, 50-54 (July-August 1978)

The use of explosive-magnetic generators in modern technology and scientific investigations as pulsed generators of high-power electrical energy has been discussed previously. The circuit for directly connecting the explosive generators into a resistive load is the simplest and most convenient, but it has limitations both with respect to the value of the load resistance and with respect to the value of the voltage developed. In this connection, in a current breaker is regarded as a necessary element in the circuit of an explosive electrical generator. We show below that the use of a pulsed matched transformer enables one to reduce these limitations considerably and to obtain satisfactory matching in many cases between the explosive-magnetic generator and a resistive load without a current breaker. 7 Refs.

Primary Keywords: Resistive Load; Explosive-magnetic Generators; Pulsed Matched Transformer; No Output Switch; Design Considerations

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## 6840

## (SWITCHES, CLOSING)

## (LASER)

## MULTICHANNEL SEMICONDUCTOR NANOSECOND SWITCH FOR EXCITATION OF COPPER VAPOR BY A TRANSVERSE DISCHARGE

V.M. Alekshandrov, D.I. Buzhinskiy, I.V. Grekhov, M.E. Levinshstein, A.I. Mikhaylov and V.G. Sergeev  
A.F. Ioffe Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Leningrad  
Soviet Journal Of Quantum Electronics, Vol. 11, No. 1, pp 111-113 (01/1981)  
Trans. From: Kvantovaya Elektronika 8, 191-193 (January 1981)

A high-power semiconductor nanosecond switch, in the form of a thyristor structure activated by a laser pulse, was investigated. This switch could handle currents up to approximately  $5 \times 10$  kA under voltage of 25 kV in a time of approximately 1 nsec. The principle of its operation ensured synchronous triggering of several switches with an accuracy of 0.1-0.01 nsec. These switches could be connected in series and could be used effectively to pump lasers excited by transverse discharges. 11 Refs.

Primary Keywords: Thyristor; Multichannel; Laser Triggering; Very Low Inductance; Parallel Operation; Series Operation

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## 6841

## (ELECTROMAGNETIC FIELD GENERATION)

## (Magnetic)

## OBTAINING POWERFUL MAGNETIC FIELDS BY MEANS OF A POWERFUL CAPACITOR BANK

A.I. Pavlovskiy, E.N. Smirnov and V.N. Suvorov  
Instruments And Experimental Techniques, Vol. 18, No. 3, pp 932-934 (06/1975)  
Trans. From: Pribury i Tekhnika Eksperimenta 3, 214-216 (May-June 1975)

A field having an intensity of 1.9 kOe in a volume approximately  $1 \text{ cm}^3$  with a rise time approximately 10 microseconds was obtained in the discharge of a powerful MKB-1 capacitor bank having an energy capacity of 1.35 MJ. A qualitative analysis is made of the surface effect in a cylindrical current-carrying conductor; it is noted that for a field approximately 1.7 Mho the explosion of the current-carrying layer is observed. 3 Refs.

Primary Keywords: Magnetic Field Generation; Capacitor Bank Voltage Source; One-turn Solenoid; Low Inductance; Field Diffusion; Peak Field Reduction

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6842  
(BREAKDOWN STUDIES)  
(Electrolytes, Electrical)  
ON THE NATURE OF PULSED ELECTRIC BREAKDOWN OF AQUEOUS ELECTROLYTES  
V.Ya. Usakov, D.P. Semkina and V.V. Ryumin  
Academy of Sciences of the USSR, Tomsk, USSR  
Applied Electrical Phenomena, No. 2, pp 37-42 (04/1972).  
Trans. From: Elektronnaya Obrabotka Materialov 2, 48 (1972).  
The breakdown characteristics of aqueous electrolytes are presented in this paper. The effect of conductivity on pulsed breakdown voltage and delay is presented for highly nonuniform fields in electrolytes 100-1E6 ohm-cm. Voltage pulses in the range of 10 ns to 50 microseconds are used. A model for pulsed electrolyte breakdown is proposed. 15 Refs.  
Primary Keywords: Aqueous Electrolytes; Pulse Electrical Breakdown; Electric Strength; Discharge Delay Time; Discharge Development Studies; Ionic Conductivity  
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6850  
(SWITCHES, CLOSING; BREAKDOWN STUDIES)  
(Gas Gaps, Self; Gas, Electrical)  
PULSED BREAKDOWN OF SMALL GAPS IN THE NANOSECOND RANGE  
Yu.E. Mesterkhin, V.S. Komel'kov and E.Z. Melikhov  
Soviet Physics-Technical Physics, Vol. 9, No. 1, pp 29-39 (07/1964).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 34, 40-52 (January 1964).  
Breakdowns in the nanosecond range are interesting not only because of the numerous practical applications (fast circuits, circuits for shaping pulses with steep fronts, etc.), but also because the times of certain elementary processes (for instance, the processes of deexcitation of excited molecules, cumulative increase, etc.) are in this range commensurable with the time of the phenomenon itself. This fact produces a noticeable effect on the statistics of the breakdown lag time, which does not conform to the usual normal distribution. In contrast to Fletcher's experiments, we used pulses with steeper fronts, high-resolution equipment, and variation of the gas pressure in the gap, which made it possible to determine breakdown lag times by using overvoltages higher than those in earlier investigations. 14 Refs.  
Primary Keywords: Spark Gap; Nanosecond Range Breakdowns; Breakdown Lag Time; Steeper Fronts; High-resolution Equipment; Gas Pressure Variation  
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6857  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
SPARK DISCHARGE EMISSION IN HELIUM  
M.P. Vanyukov, A.A. Mak and V.P. Muratov  
Optics And Spectroscopy, Vol. 8, No. 4, pp 233-236 (04/1960).  
Trans. From: Optika Spektrosk 8, 439-445 (April 1960).  
This paper reports the spectroscopic study of a high-pressure (2.5-12 atm) discharge in helium. The spectrum is divided into two categories: spark lines, which occur at the initiation of the discharge; and air lines, which occur later. The temporal profile of the spectrum is presented. The authors present an estimate of electron density as a function of time. 15 Refs.  
Primary Keywords: Breakdown Study; Helium; Emission Spectrum; Temporal History; Electron Density  
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6858  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
STABILIZATION OF A PINCHED HIGH-CURRENT DISCHARGE BY MEANS OF A PLASMA JET  
V.B. Voronich, N.M. Gurtova, I.V. Podmoshenskii and P.N. Rogovtsov  
Soviet Physics-Technical Physics, Vol. 25, No. 5, pp 606-611 (05/1980).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 50, 1009-1014 (May 1980).  
The feasibility of maintaining an unbounded current channel in a high-current gas discharge open to the ambient medium, for a period several times as long as the hydromagnetic instability development time, has been studied. The result was achieved by forcing a hot jet of erosion plasma up the channel. This discharge was supplied from a capacitor bank storing 150 kJ of energy. A single current pulse with an amplitude of 100-200 kA and a 300 microsecond duration was generated. These conditions gave rise to a dense plasma with  $n_{\text{sub}}/e$  approximately  $1E19$  cu. cm. and  $T=20,000-30,000$  deg K. This indicates the feasibility of developing a stable open light source with a bright plasma and a broad radiation spectrum, with flash lasting much longer than the glow life of existing nonsteady open light sources. This phenomenon of discharge stabilization can also be utilized in PHD accelerators. 15 Refs.  
Primary Keywords: Discharge Channel; Unbounded Channel; Plasma Jet Stabilization; 200 kA Discharge Current; Plasma Density Measurement; Plasma Temperature Measurement  
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6865  
(ENERGY STORAGE, MECHANICAL; ENERGY STORAGE, INDUCTIVE)  
(Rotating Machines, Charging)  
THE CHARGING OF INDUCTIVE STORAGE DEVICES BY MEANS OF ELECTRICAL ROTARY AGGREGATES  
E.A. Zotova, I.A. Ivanov, A.I. Karasev and V.A. Trukhin  
Power Engineering, Vol. 15, No. 4, pp 62-68 (01/1977).  
Trans. From: Izvestiya Akademii Nauk SSSR, Energetika i Transport 15, 62-75 (1977).  
Inductive energy is a viable form of storing large amounts of energy in a small volume. The author presents a scheme for charging the inductor without loading the power grid unnecessarily. A rotary aggregate is used to supply over 1E5 J to the inductor at a rate exceeding 300 kA. Power conditioning of the charging system is discussed. 8 Refs.  
Primary Keywords: Electrical Rotary Aggregates; Inductive Storage Device Charging; Maximum Initial Excitation Current; 1E8-1E9 J Energy; 1E12 W Discharge Power  
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6869  
(SWITCHES, OPENING; ENERGY STORAGE)  
(Mechanical; Systems)  
THE TIME REQUIRED FOR TRANSFER OF CURRENT FROM A LIQUID-METAL COMMUTATOR INTO A SHUNTING CIRCUIT  
V.G. Artyukh and S.A. Smirnov  
Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Kharkov, USSR  
Instruments And Experimental Techniques, Vol. 18, No. 3, pp 819-820 (08/1975).  
Trans. From: Pribury i Tekhnika Eksperimenta 3, 126-129 (May-June 1975).  
The dependence of the time required for transfer of current into a shunting circuit on the magnitude of the current are presented which were obtained experimentally for a high-speed liquid-metal commutator for various parameters of the shunting circuit. For currents in the range from tens to hundreds of amperes this time is several or tens of microseconds. 1 Refs.  
Primary Keywords: Opening Switch; Current Transfer; Shunting Circuit; High-speed Liquid-metal Commutator; Time Dependences; Eutectic Alloy  
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6872  
(ENERGY STORAGE, INDUCTIVE; SWITCHES, OPENING)  
(Systems; Explosive Fuses)  
USE OF ELECTRIC EXPLOSION OF WIRES IN A HIGH-PRESSURE GAS TO BREAK A CURRENT CIRCUIT  
G.P. Glazunov, V.P. Kantsedal and R.V. Mitin  
Kharkov, USSR  
Journal Of Applied Mechanics And Technical Physics, Vol. 17, No. 6, pp 835-837 (12/1976).  
Trans. From: Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki 6, 102-105 (November-December 1976).  
The high energy densities stored in the magnetic field of inductive storage devices have promising applications in experimental physics. The greatest energy storage levels are achieved in superconducting storage facilities and pulsed facilities, operating with explosive-magnetic generators (currents up to 3E8 A). To use the energy stored in a magnetic field one must cut the current in the storage circuit and switch it to the load circuit. One method of doing this is to use a switch based on electrical explosion of wires (EEW). There are several difficulties in creating current cut-off devices of this type: After the electric explosion a column of metal vapor forms in which breakdown can occur; then the cut-off process is slowed and the energy-transfer efficiency is decreased. The problem is that the wire material is instantly vaporized, i.e., it is a dielectric subject to stresses arising when the inductive storage device is switched to the load. A series of tests has been conducted with different materials in order to elucidate the possible use of EEW in a high-pressure gas for current switching. 2 Refs.  
Primary Keywords: Exploding Wires; High Energy Densities; Current Cut-off Devices; Inductive Energy Storage; Opening  
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6873  
(BREAKDOWN STUDIES)  
(Gas, Optical)  
VOLUME DISCHARGE WITH UV PREIONIZATION  
V.Yu. Boranov, V.K. Bonsov, E.Sh. Napartovich, A.P. Napartovich, Yu.A. Satov and V.V. Sudakov  
I.V. Kurchatov Institute of Atomic Energy, Moscow, USSR  
Soviet Journal Of Plasma Physics, Vol. 2, No. 3, pp 266-269 (06/1976).  
Trans. From: Fiz. Plazmy 2, 486-491 (May-June 1976).  
A theoretical and experimental study has been made of the influence of the parameters of the discharge power supply circuit on the shape of the voltage and current pulses, the maximum energy disposition, and the maximum pressure at which the discharge is still a volume discharge. Measurements were carried out in a mixture of the gases CO/sub 2/, N/sub 2/, and He, which are typical of pulsed lasers, and in the pure components of the mixture. Calculations based on a simple model for the discharge in nitrogen yield time dependences for the voltage, discharge current, and total current; the value of E/P in the plasma is also found as a function of the discharge voltage, the pressure, and the circuit parameters. The calculated and experimental data agree well, permitting the conclusion that there is no typical value of the parameter E/P for the laser mixture. This parameter is found as a function of the pressure at the circuit conditions. 12 Refs.  
Primary Keywords: Gas Discharge; CO/sub 2/, N/sub 2/, He Gas Mixture; UV Preionization; Individual Gas Breakdown; Laser; Theory; Voltage Measurement; Current Measurement  
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6874  
(PULSE GENERATORS)  
(Flux Compression)  
WORK PERFORMED BY A PLANAR EXPLOSION MAGNETIC GENERATOR ON A RESISTIVE LOAD  
L.S. Gerasimov and V.I. Ikryannikov  
Institute Of Automation And Electrometry, Academy of Sciences of the USSR, Novosibirsk, USSR  
Soviet Physics-Technical Physics, Vol. 22, No. 12, pp 1497-1501 (12/1977).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 47, 2583-2589 (December 1977).  
The conversion of the energy of an explosive into electromagnetic energy by a planar explosion magnetic generator operating into a resistive load is studied. Optimization of an explosion magnetic generator on the basis of a specified criterion (a maximum voltage, a maximum power, a maximum energy, or a maximum energy, or a maximum efficiency) is examined. It is shown that explosion energy can only be converted efficiently at voltages below a certain value. Conversion of magnetic flux is not a necessary condition. 4 Refs.  
Primary Keywords: Energy Conversion; Planar Explosion Magnetic Generator; Resistive Load; Critical Voltage Value  
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- 6876  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
ANALYSIS OF THE TRUMP-VAN DE GRAAFF CONDITION FOR VACUUM BREAKDOWN  
V.A. Avrutskii and V.M. Koshchenko  
Moscow Energetics Institute, Moscow, USSR  
Soviet Physics-Technical Physics, Vol. 24, No. 9, pp 1062-1066  
(09/1979).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 49, 1889-1895 (September 1979)  
The Trump-Van de Graaff breakdown condition, which is based on the emission of electrons and ions from the electrodes, is analyzed. The starting condition for the discharge implies that each electron leaving the cathode ejects a number of ions from the anode which is sufficient to eject a single electron from the cathode. Account is taken of the ionization which occurs in the gas film adsorbed on the cathode when the electrons interact with this film. Extraction of ions into the interelectrode gap by the applied field is also taken into account. Two cases are considered: two plane electrodes, with a homogeneous field between them, and the case in which there is an insulator in the interelectrode gap. The conditions for a self-sustained discharge in vacuum are obtained. These expressions only contain values which can be found from the literature and handbooks. They explain the breakdown characteristics of vacuum gaps both qualitatively and quantitatively. 7 Refs.  
Primary Keywords: Vacuum Breakdown; Trump-Van de Graaff Condition; Field Emission; Gas Adsorption; Parallel-plane Electrodes; Interelectrode Insulator  
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- 6877  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
BEHAVIOR OF EXPLODING GOLD WIRES  
T.J. Tucker  
Sandia Labs, Albuquerque, NM 87115  
Journal Of Applied Physics, Vol. 42, No. 10, pp 1894-1900 (10/1961).  
A square wave generator current source was used to study the behavior of gold wires exploded by current densities in the range of 0.25E8 to 3.26E8 amp/cm<sup>2</sup>. Measurements of wire resistance vs cumulative energy and action at various current densities are compared with a simple theoretical exploding wire model and the results of Kerr cell photographic studies. Experimentally, the total energy input to the time of maximum wire resistance increases with current density and may exceed by threefold the normal vaporization energy. Also, the instantaneous wire resistance at any point is smaller with a larger current density. The resistance depression is first apparent in the region following vaporization. At higher current densities, the effect is observed to occur at progressively earlier phases up to and including the point at which melting occurs. 7 Refs.  
Primary Keywords: Exploding Wire; Gold Wire; 3E8 A/cm<sup>2</sup> Current Density; Wire Resistance Measurement; Temporal Resolution; Resistance Depression  
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- 6878  
(BREAKDOWN STUDIES)  
(Liquid, Electrical)  
CIRCUIT TRANSIENT FOLLOWING A PULSED DISCHARGE IN WATER  
G.B. Rakovskii  
Soviet Physics-Technical Physics, Vol. 17, No. 9, pp 1587-1590  
(03/1973).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 42, 1982-1986 (September 1972)  
The solution of the equation for a circuit that includes as an active element the spark produced following pulsed breakdown of water is analyzed. An analytic solution of the transient equation is obtained for special cases of the variation of the resistance, in which the experimental curve is approximated. This makes it possible to express the current and its derivative as functions of the time. A preliminary analysis of the limits of applicability of the results is given. 8 Refs.  
Primary Keywords: Water Breakdown; Transient Equation; Underwater Pulsed Discharge; Conduction Channel Resistance; Rate Of Energy Release; Circuit Considerations  
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- 6880  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES)  
(Gas, Electrical; Electrodes)  
CONDITIONS FOR SPUTTER EMISSION IN HIGH-PRESSURE SPATIAL GASEOUS DISCHARGES  
Yu.D. Korolev, G.A. Maslyats and V.B. Ponomarev  
Academy of Sciences of the USSR, Tomsk, USSR  
Journal Of Applied Mechanics And Technical Physics, Vol. 20, No. 6, pp 674-678 (12/1979).  
Trans. From: Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki 20, 25-29 (November-December 1979)  
The contraction of a high-pressure spatial gaseous discharge is associated with formation of a cathode spot and an outgrowth from the latter of a high-conductance spark channel. In an earlier study there was proposed a model of spot initiation under high electric field intensities  $E(0)$  at the cathode, when spontaneous emission from individual microasperities becomes significant. Then the cathodic layer is unstable relative to fluctuations of the spontaneous-emission current so that heating of their tips by the electron current and the ion current cause this layer to sputter and a cathode spot is formed. The electric field intensity  $E(0)$  is related to the ion current density  $j$  according to the law of similarity  $E(0) \propto j^{1/2} (p/\text{sup } 2)^{1/2}$ , with  $p$  denoting the gas pressure. This relation yields the dependence of the discharge current density or the pressure at a beforehand given electric field intensity  $E(0)$  sufficiently high for initiating a cathodic instability. This study will deal with the determination of the critical electric field intensities  $E_f$  and the current densities  $j_f$  in spatial discharge at which such intensities are attained. 19 Refs.  
Primary Keywords: Gas Breakdown; Cathode Spot; Cathode Sputtering; Spark Channel; Ion Current; Pressure Dependence  
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- 6882  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
EFFECT OF INHOMOGENEITY OF A TRANSVERSE MAGNETIC FIELD ON BREAKDOWN  
P.M. Tyurkanev, I.K. Fetisov and G.V. Khodachenko  
Moscow Engineering Institute, Moscow, USSR  
Soviet Physics-Technical Physics, Vol. 23, No. 9, pp 1031-1033  
(09/1978).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 48, 1809-1814 (September 1978)  
A low-pressure discharge is studied in a homogeneous electric field which is perpendicular to an inhomogeneous, axisymmetric magnetic field. The inhomogeneity of the magnetic field affects the breakdown conditions. A qualitative interpretation is offered for the experimental results. 10 Refs.  
Primary Keywords: Gas Breakdown; Low Pressure; Self-breakdown; Transverse Magnetic Field; Inhomogeneous Field; Effect On Breakdown  
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- 6883  
(BREAKDOWN STUDIES; INSULATION, MATERIAL)  
(Surface Flashover; Solid)  
ELECTRIC FIELD CONFIGURATION FOR A GRAZING DISCHARGE  
P.N. Daskov and E.K. Chistov  
M.I. Kalinin Leningrad Polytechnical Institute, Leningrad, USSR  
Soviet Physics-Technical Physics, Vol. 24, No. 6, pp 657-668 (06/1979).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 49, 1241-1244 (June 1979)  
The grazing discharge which occurs along the surface of a dielectric, is used in high-current, low-inductance switches and in pulsed light sources. On the other hand, the grazing discharge is a major problem in the normal operation of certain insulating structures and other types of electrical devices. Despite the extensive information which is now available on the electrical and physical characteristics of the grazing discharge, we do not yet have a good picture of this discharge; this situation is in contrast with the free gas discharge which develops in a highly nonuniform field. 13 Refs.  
Primary Keywords: Grazing Discharge; Surface Discharge; Closing Switch; Insulation Breakdown; Uniform Field Discharge  
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- 6885  
(SWITCHES, CLOSING; SWITCHES, OPENING)  
(Mechanical; Mechanical)  
EXPERIENCE IN SWITCHING KILOAMPERE DIRECT CURRENT BY MEANS OF LIQUID METAL  
V.A. Boguslavskii, I.M. Tolmach and E.I. Yantovskii  
Magneto-hydrodynamics, Vol. 8, No. 1, pp 138-139 (03/1972).  
Trans. From: Magnitnaya Gidrodinamika 8, 153-156 (January-March 1972)  
The most promising of current designs of liquid-metal switching devices are devices in which an electrically conducting fluid enclosed in a closed vessel takes up the positions necessary for switching an electrical circuit as in response to the action of the magnetic field associated with the control currents. The absence of mechanical displacements of rigid bodies leads to high electrical and mechanical wear resistance and to noiseless operation. These devices can be classified under two headings: conductive devices in which the displacement of the electrically conducting fluid is brought about through the interaction between the control magnetic field and the control current flowing through the liquid-metal contact and inductive devices where the effect is achieved through the interaction between the fluid and a pulsating field or traveling field of control circuits. We describe the results of experiments staged with an inductive device in which the electrically conducting fluid is displaced through its interaction with a rotating magnetic field. 4 Refs.  
Primary Keywords: Vacuum Commutator; Liquid Metal Contact; Magnetic Field Control; Performance Test; High Reliability  
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- 6885  
(SWITCHES, CLOSING; SWITCHES, OPENING)  
(Mechanical; Mechanical)  
FAST-ACTING VACUUM COMMUTATOR WITH CONNECTION BY LIQUID-METAL CONTACTS  
I.G. Galkina, O.A. Gusev, A.G. Mechev and E.P. Pavlov  
Instruments And Experimental Techniques, Vol. 20, No. 2, pp 506-508  
(04/1977).  
Trans. From: Pribury i Tekhnika Eksperimenta 2, 161-163 (March-April 1977)  
The construction and operating principles of a fast-acting commutator with connection by liquid-metal contacts are described. With a contact surface area of approximately 20 mm<sup>2</sup> and a resistance of no more than 3-5 microhm in the closed state, the commutator transmits a current of up to 5 kA for a long period of time and also conveys current from an inductance bank to a load of 5 ohm and 10 microhenry, with an artificial current zero in 20-30 microseconds. 2 Refs.  
Primary Keywords: Vacuum Commutator; Liquid-metal Contacts; Fast Opening; 5 kA Operating Current  
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- 6887  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Gas, Electrical; Gas Gaps, Electrical)  
FORMATION OF A MULTICHANNEL SPARK IN AIR  
V.P. Beloshev  
Soviet Physics-Technical Physics, Vol. 24, No. 10, pp 1201-1202  
(10/1979).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 49, 2180-2182 (October 1979)  
A spark discharge in a gas-filled gap usually develops through a single channel; this feature makes it difficult to switch high-current circuits because with a current  $>1E5$  A the reduction in the resistance and inductance of the channel results from its eversion while the switching time goes as  $1/\text{sup } .33/$ . Furthermore, the high resistance of the channel in the early stage leads to a substantial energy loss, especially in the early stage. Because of those circumstances, along with the significant electrode erosion at discharge currents  $>1E5$  A, it is necessary to develop methods for forming multichannel discharges. In the present paper we propose a new method for obtaining a multichannel discharge. This method used a multichannel barrier discharge, which develops in all discharge gaps with a common cathode electrode. Study of the barrier discharge shows that its multichannel structure is governed by the rate at which the grazing discharge develops along the dielectric barrier. 5 Refs.  
Primary Keywords: Multichannel Discharge Formation; Multichannel Barrier Discharge; Low Inductance Switch  
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6892  
(BREAKDOWN STUDIES)  
(Liquid, Electrical)  
INTERFEROMETRIC STUDY OF PULSED BREAKDOWN IN A LIQUID  
V.F. Kiekin and A.G. Ponomarenko  
Novosibirsk State University, Novosibirsk, USSR  
Soviet Physics-Technical Physics, Vol. 24, No. 9, pp 1067-1071  
(09/1979)  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 49, 1896-1904 (September 1979)  
Certain new features have been observed in the initial stage of an electric discharge in a liquid dielectric at  $E_{sub} 0/$  approximately  $(0.3-1) 10^6$  V/cm in an interferometer study with time resolution approximately 5E-9 sec and spatial resolution approximately 5E-4 cm. The jumps in the refractive index and the pressure are determined by solving the Abel integral equation by a stepwise-approximation method for a shock wave; behind the shock front the primary ionization processes proceed comparatively slowly. A study of the dynamics of the shock waves lead to estimates of the basic energy relations for the initial, "hydrodynamic" stage of electric breakdown in distilled water. 15 Refs.  
Primary Keywords: Liquid Breakdown; Interferometric Diagnostic; Breakdown Stages; Shock Wave  
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6893  
(SWITCHES, CLOSING; SWITCHES, OPENING)  
(Mechanical; Mechanical)  
INVESTIGATION OF THE COMMUTATION OF A KILOAMPERE DIRECT CURRENT BY A LIQUID METAL IN A ROTATING FIELD  
V.A. Boguslavskii, I.M. Tolmach and E.I. Yantovskii  
Magnetohydrodynamics, Vol. 8, No. 4, pp 509-514 (12/1972)  
Trans. From: Magnitnaya Gidrodinamika 8, 95-101 (October-December 1972)  
A device for investigating the commutation of high currents by means of a liquid metal, consisting of a nonconducting hermetic cylinder partially filled with liquid metal, electrodes inserted into the cylinder, and an external iron-free inductor of a rotating field, is described. On connecting the inductor the liquid metal uncoils, forms a rotating conducting cylinder, and closes the main circuit. Disconnection of the inductor leads to subsidence of the liquid metal under the effect of gravity and to breaking of the circuit. Problems of a comparison of a linear device with a centrifugal device, determination of the maximum short-circuit current, and calculation of the field of an iron-free stator are discussed. Experiments on a model of a contactor with commutation of a direct current up to 1000 A at a voltage of 220 V with boosting of the control voltage upon connection and with counterrotation upon disconnection are described. 6 Refs.  
Primary Keywords: Vacuum Commutator; Rotating Magnetic Field; Liquid Metal Contact; Field Closing Driver  
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6894  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
CROWBAR GAP SWITCH WITH TWO TRIGGERING PULSES OF OPPOSITE POLARITIES  
M. Ikeda and S. Takeda  
Electrotechnical Lab, Tokyo, Japan  
The Review Of Scientific Instruments, Vol. 41, No. 11, pp 1669-1677  
(11/1970)  
A crowbar gap switch with a new triggering circuit has been designed and tested. Two trigger pulses of opposite polarities are applied simultaneously. At the time of crowbar, after a quarter cycle of main current, two pulses of opposite polarities are applied simultaneously to the trigger electrodes. These trigger electrodes break down by field emission so that a breakdown path is established. The main current flows along the path and is crowbarred. 0 Refs.  
Primary Keywords: Spark Gap; Crowbar Gap; Oval Trigonon Configuration; Double Trigger  
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6895  
(ENERGY STORAGE, INDUCTIVE; ENERGY STORAGE, CAPACITIVE)  
(Systems; Systems)  
PLASMA INJECTORS WITH CAPACITY AND INDUCTANCE ENERGY STORAGE  
M.V. Belan, M.A. Mashtylev and B.I. Panchchevnyi  
Khar'kov Aviation Institute, USSR  
Soviet Physics-Technical Physics, Vol. 16, No. 10, pp 1642-1645  
(04/1972)  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 41, 2073-2078 (October 1971)  
The acceleration of a plasma in an injector with capacity and inductance energy storage is treated. A system of equations is derived and solved numerically for capacity and inductive energy storage. The conditions under which an injector provides the same efficiency, regardless of the type of energy storage, are determined. 7 Refs.  
Primary Keywords: Plasma Injector; Inductive Energy Storage; Capacitive Energy Storage; Comparison; Efficiency  
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6902  
(BREAKDOWN STUDIES)  
(Gas, E-beam)  
PULSE DISCHARGES IN GASES UNDER CONDITIONS OF STRONG IONIZATION BY ELECTRONS  
Yu.I. Bychkov, Yu.D. Korolev and G.A. Masyska  
Academy of Sciences of the USSR, Tomsk, USSR  
Soviet Physics-Uspekhi, Vol. 21, No. 11, pp 944-958 (11/1978)  
Trans. From: Uspekhi Fizicheskikh Nauk 126, 451-477 (November 1978)  
A review is given of investigations of pulsed high-pressure volume discharges excited by fast electron beams. The following topics are discussed: classification of discharges; methods for calculating the current-voltage characteristics; analysis of the optimal ways of depositing energy in the gas in the volume stage of the discharge; discharge instability mechanisms and the corresponding experimental observations; applications of discharges. The results are given of calculations of the electric field in the cathode and anode regions, and also in the discharge column in the case of the spatially inhomogeneous ionization of the gap. It is shown that a stable volume flow of the current in molecular gases in which the specific deposited energy is  $0.1-1$  J/ccm, may be attained in a relatively sustained discharge and in a discharge with ionization multiplication. In both cases a spark channel appears in two stages: formation of spark-initiating centers in the form of plasma regions with a higher density near the electrodes is followed by growth of the spark channel from such initiating centers. In some cases the spark channel growth can be described by the available mathematical models. Discharges in mixtures of rare gases with halogen-containing compounds, when electrons are lost mainly by capture by complex molecules, are considered separately. Applications of volume discharges in laser pumping, switching of pulsed currents, plasma chemistry, etc. are dealt. 106 Refs.  
Primary Keywords: Gas Breakdown; Reviews; Volume Discharge; E-beam Excitation; Spark Channel; Discharge Classification; Initiating Centers  
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6910  
(ELECTROMAGNETIC FIELD GENERATION)  
(Magnetic)  
THEORY OF THE CNARE EFFECT  
H.G. Letal  
Illinois Institute of Technology, Chicago, IL  
Annals Of Physics, Vol. 42, No. 2, pp 32-353 (04/1967)  
The author presents a theoretical explanation for the Cnare effect (the electrical implosion of conducting liners for magnetic field compression). The diffusion of the field into the liner and subsequent implosion are considered on a quantitative basis. 9 Refs.  
Primary Keywords: Compression; Electrical Liner Implosion; Theory  
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6911  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
THEORY OF THE VACUUM ARC  
V.A. Nemchinskii  
All-Union Institute, Moscow, USSR  
Soviet Physics-Technical Physics, Vol. 24, No. 7, pp 764-767 (07/1979)  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 49, 1373-1378 (July 1979)  
A model is proposed for the cathode region of a vacuum arc. The model is closed; the calculations only require a knowledge of the arc current and the properties of the cathode material. Specific calculations are carried out for a copper cathode. The calculated values of the voltage drop across the arc, the heat transferred to the cathode, the current density, and the current per spot are all in agreement with experimental data. 13 Refs.  
Primary Keywords: Cathode Region; Vacuum Arc; Current Density; Cathode Potential Drop; Theory; Modeling  
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6914  
(BREAKDOWN STUDIES)  
(Gas, E-beam)  
VOLTAGE-CURRENT CHARACTERISTIC OF GAS DISCHARGE WITH EXTERNAL IONIZATION  
E.V. Chekhunov  
Moscow, USSR  
Journal Of Applied Mechanics And Technical Physics, Vol. 20, No. 4, pp 403-406 (08/1979)  
Trans. From: Zhurnal Prikladnoi Mekhaniki I Tekhnicheskoi Fiziki 4, 16-19 (July-August 1979)  
Steady-state solutions of the discharge equations were obtained elsewhere for a range of values of the external ionization source strength  $Q$ , discharge current  $j$ , and voltage  $U$  such that there was no impact ionization in the positive column, and the voltage was below the breakdown value. The present paper treats a broader range of variation of  $Q$ ,  $j$ , and  $U$ ; in particular, currents are considered for which impact ionization in the positive column is important, and the voltage is above the breakdown value. 4 Refs.  
Primary Keywords: Gas Breakdown; External Ionization Source; Self-sustaining Discharge; Theory; Transient Solution  
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6916  
(PARTICLE BEAMS; REVIEWS AND CONFERENCES)  
(Reviews; Conferences)  
ALL-UNION CONFERENCE ON THE APPLICATION OF CHARGED-PARTICLE ACCELERATORS IN THE NATIONAL ECONOMY  
D.A. Gusev (Ed.)  
Soviet Atomic Energy, Vol. 40, No. 3, pp 334-335 (03/1976)  
Trans. From: Atomnaya Energiya 40, 273-274 (March 1976)  
The 2nd All-Union Conference on the Application of Charged-Particle Accelerators in the National Economy was held on October 1-3, 1975 in Leningrad. Specialists from 53 organizations and companies of the Soviet Union participated in the conference, representing the Academy of Sciences of the Soviet Union, the State Committee for Nuclear Energy Research, the chemical, petrochemical, electronic, textile, radio and electrotechnical, timber and tree cultivation, power engineering industries, the Ministries of Public Health and Higher Education. Specialists from Poland, the German Democratic Republic, Czechoslovakia, and Hungary also participated. More than 80 papers were heard on the problems of the development, construction and operation of different types of accelerators, and also their application in radiation chemistry, for industrial defectoscopy and activation analysis, for the sterilization of manufactured goods, the prevention of contamination of the environment, and radiation therapy. 0 Refs.  
Primary Keywords: Charged-particle Accelerators; Development Practical Application; Construction And Operation; Radiation Chemistry; Industrial Defectoscopy; Activation Analysis; Radiation Therapy  
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921  
(SWITCHES, CLOSING)  
(Thyratrons)  
CONTROLLED MEGAVOLT GAS-FILLED DISCHARGER  
V. M. Evdokimovich, B. Evlampiev, G. S. Korshunov, V. A. Nikolaev, Yu. F. Sviridov and V. B. Rkmyrov  
Tomsk Polytechnic Institute, Tomsk, USSR  
Instruments and Experimental Techniques, Vol. 23, No. 5, pp 1190-1192  
(1978)  
Trans. From Priroda i Tekhnika Eksperimenta 5, 127-128  
(September-October 1980)  
A megavolt gas-filled thyratron-type discharger is described with a sectional gas-discharge chamber, having a delay or spark ignition of  $\tau_{sub} = 10$  to  $20$   $\mu$ s, microsecond together with a more than threshold range of operating voltage. A dielectric bushing is used in the ignition assembly of the thyratron projecting above the plane of the base electrode. 3 Refs.  
Primary Keywords: Megavolt Gas-filled Discharger; Thyratron; 10  $\mu$ s; 1 Microsecond Spark Ignition Delay; Trigger Bushing; 20  $\mu$ s Microsecond Voltage Application Time; Thyratron Ignition Assembly; Sectional Discharge Chamber  
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1978  
CROCKDOWN STUDIES, SWITCHES, CLOSING)  
(Electrodes: Gas Gases, Materials)  
EFFECT OF THE MEDIUM ON THE ELECTRICAL EROSION OF ELECTRODES AT HIGH  
CURRENTS

G.S. Belkin and V.Ya. Kisilev  
Moscow Energetics Institute, Moscow, USSR  
Soviet Phys.-Technical Physics, Vol. 25, No. 1, pp 24-27 (01/1978).  
Trans. from Zhurnal Tekhnicheskoi Fiziki 48, 42-48 (January 1978).

Devices with high closed currents are widely used in the laboratory and in industry. High currents through the working and switching gaps cause electrode wear, so that the electrode shape is changed and the insulation and the medium become contaminated. The quantitative characteristics of the electrode wear are reported by the authors. The mechanism of the erosion of the medium is not well understood. Our purpose in the present work is to compare the erosion processes in discharges in various media and to determine the characteristics of the erosion in dense and low-density media. The critical current and current pulse lengths of tens or hundreds of micro-seconds have much in common with signals to 50-Hz currents. We therefore report results for both short pulses and for current pulses at 50 Hz, 10 kV.

Primary Parameters: Electrode Erosion; Pulsed Current; Power Line; Frequency Current; Insulation Contamination; Discharge Parameter Variation; Copper Electrodes; Theory.

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6929  
(BREAKDOWN STUDIES)  
(Gas, E-beam)  
ELECTRIC FIELD DISTRIBUTION IN THE ANODE LAYER OF A NON-SELF-MAINTAINED VOLUMETRIC DISCHARGE SUSTAINED BY A BEAM OF FAST ELECTRONS  
Yu. D. Korolev, V. V. Kremnev and V. B. Ponomarev  
Institute of Atmospheric Optics, Academy of Sciences of the USSR, Moscow, USSR  
Soviet Physics Journal, Vol. 26, No. 3, pp 406-409 (03/1977).  
Trans. From: Izvestiya Vysishikh Uchebnykh Zavedenii 20, 150-152 (March 1977)

The interest in the study of the electrode layers of non-self-maintained discharges is connected with the fact that the character of the distribution of charged particle in these layers to a considerable extent determines the mechanism of conduction. An additional stimulus to the research arose when it was noted that the formation of spark channels, which lead to the cutoff of the volumetric flow of current, begins in the regions near the electrodes. In the work done earlier the principal attention was paid to the calculation of the characteristics of the cathode layer. The results of analytical and numerical calculations of the anode region of a non-self-maintained discharge are presented in this report. 9 Refs.

Primary Keywords: Gas Discharge; Volume Discharge; E-beam Sustained Discharge; Spark Channel; Cathode Layer; Anode Layer  
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6930  
(BREAKDOWN STUDIES)  
(Explosives)  
ELECTRIC STRENGTH OF SCATTERED DETONATION GASES  
P. I. Zubkov, L. A. Luk'yanchikov and Yu. V. Ryabinin  
Novosibirsk, USSR  
Journal of Applied Mechanics And Technical Physics, Vol. 19, No. 1, pp 109-110 (02/1976).  
Trans. From: Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki 1, 134-138 (January-February 1976)

One of the most important characteristics in schemes used for the formation of high-power pulses of a given shape by means of condensed explosives is the current density that can be attained in the detonation wave. Whenever the electrical conductivity is determined directly by the detonation process, the maximal current density depends on the maximal electric field strength at which breakdown of the detonation gases no longer occurs, i.e., on their electric strength. This magnitude also determines the characteristics of safety detonators operating at high inverse voltages. Prediction of the parameters of detonators maintained at a high voltage requires knowledge of the electric strength of the detonation gases as a function of pressure. This is because the gaps formed as current is switched off are found under conditions characterized by nonstationarily expanding explosion gases, as a result of which their electric strength is time-dependent as a function of pressure. The required parameters of safety detonators can be obtained from a joint solution of the gasdynamic scatter problems for detonation gases and the motion of current-carrying elements and of electric circuit equations if the dependence of electric strength on pressure is known. In the current work, fundamental results are set forth from an experimental study of the electric strength of expanding detonation gases from bulk density PETN and Hexogen charges. 6 Refs.

Primary Keywords: Electrical Pulse Generator; Condensed Explosive; Detonation Wave; Detonation Product Breakdown; Maximum Current Density; PETN Explosive  
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6931  
(BREAKDOWN STUDIES; SWITCHES; CLOSING; SWITCHES; OPENING)  
(Gas, E-beam; Gas Gaps; E-beam; Gas Gaps; E-beam)  
ELECTRIC-FIELD INSTABILITIES OF A VOLUME GAS DISCHARGE EXCITED BY AN ELECTRON BEAM  
G. A. Masyata  
Academy of Sciences of the USSR, Tomsk, USSR  
Soviet Technical Physics Letters, Vol. 1, No. 7, pp 292-298 (07/1975).  
Trans. From: Pis'ma Zhurnal Tekhnicheskoi Fiziki 1, 660-664 (July 1975)

A volume discharge excited by an electron beam in a gas at atmospheric pressure and higher is used in CO/sub 2/ lasers, in gas-based switches, in plasmatrons, etc. The principal feature of this discharge is the transition from the volume mode into a channel mode. It has been proposed that this transition is caused by instabilities that arise in the plasma. We believe that under certain conditions this transition can also be due to the spatial inhomogeneity of the electric field. 11 Refs.

Primary Keywords: Volume Gas Discharge; Spatial Inhomogeneity; Cathode Instability; Ionization Instability; Injection Instability  
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6932  
(BREAKDOWN STUDIES)  
(Explosives)  
ELECTRIC CONDUCTIVITY IN THE DETONATION ZONE OF CONDENSED EXPLOSIVES  
P. I. Zubkov, L. A. Luk'yanchikov and B. S. Novoselov  
Novosibirsk, USSR  
Combustion, Explosion, And Shockwaves, Vol. 7, No. 2, pp 253-256 (06/1971).

Trans. From: Fizika Goreniya i Vzryva 7, 295-299 (April-June 1971)  
It is known that a zone of relatively high electrical conductivity occurs upon detonation of condensed explosives. Thermal ionization, chemical reactions, and high densities that developed in the detonation wave can be the cause of formation of the zone of electrical conductivity. It is not possible to determine separately the effect of each of these phenomena on the basis of what is known, since for this purpose it is necessary to know the character of the carriers and the distribution of conductivity in the region of the detonation wave. Here we present experimental data on a determination of the distribution of conductivity in the detonation zone. The measurements were taken during detonation of powdered PETN with a density of 1.1 g/ccm. and RDX with a density of 1.2 g/ccm. 5 Refs.

Primary Keywords: Explosive Detonation Product; Conductivity Measurement; Conductivity Distribution; Detonation Wave; Powdered PETN Explosive  
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6933  
(BREAKDOWN STUDIES)  
(Solid; Electrical)  
ELECTRICAL DISCHARGE IN PENTAERYTHRITOL TETRANITRATE POWDER  
P. I. Zubkov and L. A. Luk'yanchikov  
Novosibirsk, USSR  
Journal of Applied Mechanics And Technical Physics, Vol. 11, No. 4, pp 637-640 (08/1970).  
Trans. From: Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki 4, 128-131 (July-August 1970)

The article presents some results of oscillographic investigations of an electric discharge in pentaerythritol tetranitrate (PETN) powder of density 0.5-1.2 g/ccm. A hydrodynamic model of the development of the current-conducting channel was used; estimates of the rate of its development and values of its radius and of conductivity in it are given. It is shown that the transformation products of PETN have a conductivity not above 7E6 sec. 5 Refs.

Primary Keywords: PETN Powder Breakdown; Oscillographic Investigations; 5-1.2 g/ccm. Powder Density; 7E6 Sec Transformation Product Conductivity; Discharge Plasma Conductivity; Current Cutoff  
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6934  
(BREAKDOWN STUDIES)  
(Explosives)  
ELECTRICAL STABILITY OF DETONATION PRODUCTS OF CONDENSED EXPLOSIVES  
P. I. Zubkov, L. A. Luk'yanchikov and Yu. V. Ryabinin  
Novosibirsk, USSR  
Journal of Applied Mechanics And Technical Physics, Vol. 19, No. 3, pp 315-318 (06/1978).  
Trans. From: Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki 3, 44-47 (May-June 1978)

The development of the various areas of experimental 1 physics and technology requires the creation of high-power, high-speed switching devices. The most promising from the point of view of obtaining the necessary switching parameters are commutators based on the use of condensed explosives. A study of the electrical properties of the detonation products of explosives, filling the gaps in the electrical chain and defining the switching characteristics of circuit breakers, has been stimulated by the creation of the optimum design of an explosive switch. The electrical stability of the detonation products of a charge of PETN (pentaerythritol tetranitrate), located between the ends of cylindrical electrodes, was previously investigated. It is shown that, with the experimental accuracy, the stability of the gap up to a specified stage of expansion of the detonation products is constant (E=100-120 kV/cm). Later, the stability falls rapidly. In the present paper the principal experimental results of an investigation of the electrical stability of the exploding detonation products of condensed explosives under the condition that their density is considerably lower than the density in the detonation wave and also of the static stability of the products in the pressure range 1-11 atm are given. 3 Refs.

Primary Keywords: Explosive Detonation Products; Electrical Stability; High-power Switch; Gas Density Dependence  
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6935  
(BREAKDOWN STUDIES)  
(Gas, E-beam)  
ENERGY INPUT IN ELECTRICAL IONIZATION LASERS  
Yu. I. Zychkov, Yu. A. Kurbatov and G. A. Masyata  
Academy of Sciences of the USSR, Tomsk, USSR  
Soviet Physics-Technical Physics, Vol. 19, No. 4, pp 599-592 (10/1974).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 44, 791-796 (April 1974)

The development of a volume discharge excited by a beam of fast electrons is studied at pressures P>1 atm. The current characteristics are calculated allowing for the parameters of the discharge circuit and the energy input to the gas is analyzed. For P=2 atm the specific energy introduced into a mixture of N/sub 2/ and CO/sub 2/ is W/sub g/ approximately 1 J/ccm. These values are achieved at a current density in the electron beam j/sub beam/ approximately 5-10 A/sec. cm. and a beam lifetime tau/sub beam/ approximately 4E-8 sec. It is shown that maintenance of the discharge by ionization processes permits a substantial reduction in the beam current while maintaining acceptable energy characteristics and sparkless operation. For example, W/sub g/ approximately 0.1 J/ccm. with j/sub beam/ approximately 0.1 A/sec. cm. and tau/sub beam/ approximately 2E-8 sec. 10 Refs.

Primary Keywords: E-beam Excited Discharge; Volume Discharge; Circuit Parameter Variation; Energy Input; Beam Current Reduction  
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6936  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES)  
(Gas, Electrical; Electrodes)  
EXPLOSIVE PROCESSES AT THE CATHODE OF A GAS DISCHARGE  
G. A. Masyata  
Academy of Sciences of the USSR, Tomsk, USSR  
Soviet Technical Physics Letters, Vol. 1, No. 10, pp 385-386 (10/1975).  
Trans. From: Pis'ma Zhurnal Tekhnicheskoi Fiziki 1, 885-888 (October 1975)

Numerous experimental investigations of the vacuum discharge have demonstrated the fundamental role played by explosive emission of electrons in the initiation of the discharge and maintenance of the cathode spot. The electric field in the gap in vacuum breakdown is approximately 1E6 V/cm, but the field at the cathode becomes stronger because of microscopic inhomogeneities. To observe explosive processes at the cathode in a nanosecond discharge in a gas we have investigated the microstructure of the cathode. It is known from an investigation of the vacuum discharge that the explosive emission leads to the formation of microscopic craters on the cathode. Microscopic craters have been observed in a discharge in atmosphere. 10 Refs.

Primary Keywords: Gas Discharge; Explosive Electron Emission; Cathode Spot; Nanosecond Discharges; Microscopic Craters; Copper Electrodes  
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6937  
(PULSE GENERATORS)  
(FLUX COMPRESSION)  
EXPLOSIVELY-DRIVEN MAGNETIC GENERATOR WITH FAST MEGAGAUSS FIELD  
L.V. Bebarina, D.P. Sobolev and A.E. Voitenko  
Institute Of Nuclear Physics, Academy of Sciences of the USSR,  
Novosibirsk, USSR  
Astronautica ACTA, Vol. 15, pp 292-299 (01/1970).  
The authors describe a magnetic flux compression generator  
utilizing a flat geometry. The generator is designed so that the  
compression cavity forms its own closing switch. It is hypothesized  
that skin-depth evaporation limits magnetic field intensity. Fields  
of 1.5 MG and current rise rates of 7E11 A/sec are reported. 5 Refs.  
Primary Keywords: Flux Compression Generator; Plane Geometry; 7E11  
A/sec Current Rise Rate; Self-closing Switch;  
Aluminum Plates; Copper Plates; Skin-depth Plate  
Evaporation  
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6938  
(ELECTROMAGNETIC FIELD GENERATION; PULSE GENERATORS)  
(Magnetic; Flux Compression)  
FLUX LOSS IN THE PRODUCTION OF ULTRA-STRONG FIELDS BY RAPID COMPRESSION  
OF CONDUCTING SHELLS  
V.I. Yurchenko  
Institute Of Nuclear Physics, Academy of Sciences of the USSR,  
Novosibirsk, USSR  
Soviet Physics-Technical Physics, Vol. 19, No. 8, pp 1031-1033  
(02/1975).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 44, 1650-1655 (August 1974)  
The flux-loss problem is written as a system of two equations  
under the assumption that the shell compressing the flux is solid and  
that certain parameters, which are functions of the shell geometry  
alone, are specified. These equations are solved for certain  
particular cases of compression. Despite the loss through the sliding  
contact, the field amplification is much higher in systems in which  
the shell contour decreases in length during the compression. 7 Refs.  
Primary Keywords: Flux Compression; Metallic Liner Implosion; Driver  
Geometry Considerations; Theory; Numerical  
Calculation  
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6939  
(BREAKDOWN STUDIES)  
(Gas; E-beam)  
FORMATION OF A SPARK CHANNEL IN A BULK DISCHARGE INITIATED BY A  
FAST-ELECTRON BEAM  
Yu.D. Korolev and A.P. Khuzeev  
Institute Of Atmospheric Optics, Academy of Sciences of the USSR,  
Moscow, USSR  
High Temperature, Vol. 13, No. 4, pp 779-780 (08/1975).  
Trans. From: Teplofizika Vysokikh Temperatur 13, 861-862 (July-August  
1975).  
High-pressure bulk discharges excited by an external ionization  
source, e.g., a beam of accelerated electrons, have been used to pump  
gas lasers and to switch powerful pulsed currents. In both cases, it  
is important to prevent breakdown of the spark channel. Breakdown  
delay time at different gas pressures and in different mixtures has  
been measured. In the present paper the dynamics of channel formation  
are investigated directly by observing the light patterns of  
discharge development. 8 Refs.  
Primary Keywords: Gas Discharge; E-beam Sustained Discharge; Volume  
Discharge; Spark Channel Formation; Photographic  
Diagnostic  
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6942  
(BREAKDOWN STUDIES)  
(Gas; Electrical)  
GROWTH OF A NANOSECOND PULSED DISCHARGE IN A GAS WITH ONE-ELECTRON  
INITIATION  
V.V. Kremnev and G.A. Mesyats  
Academy of Sciences of the USSR, Tomsk, USSR  
Journal Of Applied Mechanics And Technical Physics, Vol. 12, No. 1, pp  
33-37 (02/1971).  
Trans. From: Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki 1,  
40-45 (January-February 1971).  
Pulse breakdown on gaps of millimeter order at substantial  
overvoltages is explained in terms of a discharge mechanism involving  
photoelectric emission from the cathode followed by collisional  
multiplication in the gas to give avalanches. The mechanism is used  
to deduce a theoretical equation for the time of discharge buildup in  
one-electron initiation, which is compared with experiment. 17 Refs.  
Primary Keywords: Nanosecond Pulsed Discharge; Discharge Buildup Time;  
Avalanche Theory; Streamer Mechanism; One-electron  
Initiation  
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6946  
(SWITCHES, CLOSING)  
(Liquid Gaps; Optical)  
LASER IGNITION OF THE WATER DISCHARGER FOR THE TWIN PULSE-FORMING LINE  
OF AN ELECTRON ACCELERATOR  
B.A. Demidov, M.V. Ivkin and V.A. Petrov  
Instruments And Experimental Techniques, Vol. 23, No. 4, pp 904-906  
(08/1980).  
Trans. From: Priroda i Tekhnika Eksperimenta 4, 93-95 (July-August  
1980).  
In experiments on the laser ignition of a water discharger for the  
twin pulse-forming line of the Kalmar precision pulse electron  
accelerator using a 300-MW laser pulse, we have been successful in  
triggering a water discharger with an average time spread of not more  
than  $\sim 8$  nsec at a voltage between electrodes of 600 kV. Laser  
switching reduces the rise time of the pulse being formed by 10-15%  
and reduces the energy loss in the discharger by a factor of 1.5. 6  
Refs.  
Primary Keywords: Water Spark Gap; Laser Triggering; 600 kV Operating  
Voltage; 16 ns Jitter; 10% Rise Time Reduction  
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6947  
(BREAKDOWN STUDIES)  
(Vacuum; Electrical)  
MECHANISM FOR NANOSECOND VACUUM PULSED DISCHARGE  
L.P. Babich and M.D. Terev  
Radiophysics And Quantum Electronics, Vol. 23, No. 11, pp 914-920  
(11/1980).  
Trans. From: Izvestiya Vysshikh Uchebnykh Zavedenii, Radiofizika 23,  
1365-1372 (November 1980).  
Spectral analysis is used to demonstrate the absence of a  
near-cathode plasma flame for nanosecond electric discharges in a  
vacuum. Arguments are presented in support of a thermoemission  
mechanism for the discharge current. The place and role of the  
desorption mechanism and breakdown of insulating films in the  
development of the discharges are discussed. 20 Refs.  
Primary Keywords: Vacuum Breakdown; Cathode Flame; Thermoemission;  
Insulating Film; Desorption  
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6948  
(BREAKDOWN STUDIES)  
(Liquid; Electrical)  
MECHANISM OF THE PULSED ELECTRICAL BREAKDOWN OF WATER  
E.V. Yan'shin, I.T. Ovchinnikov and Yu.N. Varshinin  
Institute Of Automation And Electrometry, Academy of Sciences of the  
USSR, Novosibirsk, USSR  
Soviet Physics-Doklady, Vol. 19, No. 2, pp 95-96 (08/1974).  
Trans. From: Doklady Akademii Nauk SSSR 214, 1303-1307 (February 1974)  
The main factors governing the nature of liquid dielectric  
breakdown are the conductivity and the duration of the effective  
voltage. Depending on the combination of these factors, it is assumed  
that breakdown is accomplished either by a thermal or an ionization  
mechanism. This last is considered responsible for the breakdown of  
pure liquids by pulses of  $\leq 10^{-6}$  sec duration. However, using  
ionization mechanisms to explain experimental results encounters  
significant difficulties and needs additional assumptions. The  
following mechanism for pulsed breakdown of water is proposed. The  
action of voltage on the discharge gap is accompanied by the origin  
of a positive surface charge on the anode, formed by electron  
vacancies. Polarization and displacement of the nearest water  
molecules, completing the passage of electrons from these molecules  
to the anode, occurs in the field of these vacancies. In turn,  
ionization of the water molecules results in the formation of  
hydroxone ions near the anode. Further charge transfer to the cathode  
occurs by ion migration, with the sole difference that the rate of  
this process is determined to a great extent by the proton skipping  
time, since the water molecules turn out to be already favorably  
oriented in a strong electrical field. 7 Refs.  
Primary Keywords: Water Breakdown; Pulsed Breakdown; Proton Mobility;  
Anode Surface Charge; Positive Charge Transfer  
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6949  
(INSULATION, MATERIAL; BREAKDOWN STUDIES; POWER CONDITIONING)  
(Liquid; Electrical; Systems)  
MEGAVOLT ENERGY-CONCENTRATING DEVICE  
E.A. Abramyan, V.A. Kornilov, V.M. Lagunov, A.G. Ponomarenko and R.I.  
Soloukhin  
Institute Of Theoretical And Applied Mechanics, Siberian Branch,  
Academy of Sciences of the USSR, Novosibirsk  
Soviet Physics-Technical Physics, Vol. 16, No. 11, pp 983-985 (05/1972).  
Trans. From: Doklady Akademii Nauk SSSR 204, 56-59 (November 1971)  
In research related to pulsed energy sources, one encounters  
several problems requiring beams of relativistic electrons with power  
1E12 - 1E14 W for heating plasmas, for the coherent acceleration of  
ions, and for the generation of giant flashes of x-ray radiation or  
uhf radiation. Powers of this order of magnitude are usually obtained  
in the following fashion: electric energy with the density  $\rho_{\text{sub}}/0.7$   
is initially stored in a large volume and then transferred, within a  
short time interval, into an area with increased energy density,  
wherein  $\rho_{\text{sub}} > \rho_{\text{sub}}/0.7$ . Following a suggestion of G.I. Budker, we  
discuss in the present article the possibility of using specially  
purified distilled water as a dielectric in energy-density increasing  
devices operated at voltages in excess of 1E6 V. Due to the high  
dielectric constant of water,  $\epsilon_{\text{sub}}=80$ , and the relatively high  
breakdown strength 5E5 kV/cm, it is possible to obtain specific  
powers  $p$  approximately 3E9 W at the load in the case of an optimized  
system for increasing the energy density. We mention for comparison  
that the use of other dielectric materials (transformer oil or  
polyethylene) in similar devices decreases  $p$  by approximately two  
orders of magnitude. Water has still another advantage over other  
dielectrics: the electric breakdown strength of water is restored  
after uncontrollable discharges. 7 Refs.  
Primary Keywords: Pressurized Water Dielectric; Tesla Transformer;  
Water Transmission Line; Multimegavolt Output; Water  
Breakdown Tests  
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PERMISSION

6951  
(BREAKDOWN STUDIES)  
(Gas; Electrical)  
NANOSECOND FORMATION TIME OF DISCHARGES IN SHORT AIR GAPS  
G.A. Mesyats, Yu.I. Bychkov and A.I. Iskol'dskii  
Tomsk Polytechnic Institute, Tomsk, USSR  
Soviet Physics-Technical Physics, Vol. 13, No. 8, pp 1051-1055  
(02/1969).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 38, 1281-1287 (August 1968).  
The formation time of a discharge in air gaps about one millimeter  
long, where the rise time of the breakdown pulse is 2.5E-10 sec, was  
investigated. It is shown that when breakdown is initiated by single  
electrons the time is much larger than in the case of multi-electron  
initiation. This is due to self-arrest of the avalanches by the ion  
space-charge field. In the case of multi-electron initiation the  
increase in current during time is due to the development of a large  
number of avalanches from the initiating electrons. 15 Refs.  
Primary Keywords: Formative Time Lag; Air Gaps; 1 mm Gap;  
Single-electron Initiation; Multi-electron  
Initiation; Ion Space Charge  
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PERMISSION

6952  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
ON POSSIBILITIES OF TRANSFORMER TYPE ACCELERATORS  
E.A. Abramyan  
Institute Of Nuclear Physics, Academy of Sciences of the USSR,  
Novosibirsk, USSR  
Nuclear Instruments And Methods, Vol. 59, No. 1, pp 22-28 (02/1968).  
The MeV direct transformer type accelerators are reviewed. Units  
generating electron beams of mean power of tens of kW and machines  
with pulse power of 1E8-1E9 W and frequency of several tens of cps  
are described. The efficiency of the first type accelerators is  
90-95% that of the second type is up to 80-90%. The main parameters  
of several accelerators are given. Possibilities of increasing the  
highest energies of such driven intensive proton beam accelerators  
and other problems are discussed.  
Primary Keywords: E-beam; Transformer Accelerator; Rep-rated; High  
Efficiency; Tesla Transformer  
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6953  
(BREAKDOWN STUDIES)  
(Liquid, Electrical)  
OPTICAL STUDY OF NANOSECOND PREBREAKDOWN PHENOMENA IN WATER  
E.V. Yashin (1), I.I. Chichinnikov (1) and Yu.N. Vershinin (2)  
(1) Institute Of Automation And Electrometry, Academy of Sciences of  
the USSR, Novosibirsk, USSR  
(2) Scientific-Research Institute Of Energetics, Novosibirsk  
Soviet Physics-Technical Physics, Vol. 18, No. 10, pp 1303-1306  
(04/1974).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 43, 2067-2074 (October 1973)  
An experimental study has been made of the characteristic emission  
and shadow patterns of the initial stage of a discharge in a highly  
inhomogeneous field with the point electrode held at positive and  
negative polarities. A 'quasishole' mechanism for the electrical  
conductivity of water in an intense electric field is proposed to  
explain the experimental results. A non-ionization criterion is  
formulated for the pulsed breakdown of water. 12 Refs.  
Primary Keywords: Experiment; Inhomogeneous Field; 'Quasishole';  
Non-ionization  
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6955  
(PULSE GENERATORS)  
(Pulse Forming Lines)  
PUMPING OSCILLATOR FOR LASERS HAVING TRANSVERSE EXCITATION  
V.F. Losav, V.F. Iarosenko and A.I. Fedorov  
Academy of Sciences of the USSR, Tomsk, USSR  
Instruments And Experimental Techniques, Vol. 19, No. 5, pp 1423-1494  
(10/1976).  
Trans. From: Pribery i Tekhnika Eksperimenta 5, 213-214  
(September-October 1976)  
An oscillator is described in which strip lines based on ceramic  
having a high permittivity are used. The oscillator is distinguished  
by its compactness and allows synchronized radiation pulses to be  
obtained in several directions. 5 Refs.  
Primary Keywords: Pumping Oscillator; High Permittivity Strip Lines;  
Synchronized Radiation Pulses; Traveling Excitation  
Wave; Minimum Inductance  
Secondary Keywords: Gas Laser Pumping  
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6956  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Gas, E-beam; Gas Gaps, E-beam)  
SOME CHARACTERISTICS OF A SPARK DISCHARGE INITIATED BY AN ELECTRON BEAM  
V.G. Emel'yanov, B.M. Koval'chuk and Yu.F. Potolitsyn  
Institute Of Atmospheric Optics, Academy of Sciences of the USSR,  
Moscow, USSR  
Soviet Physics Journal, Vol. 17, No. 5, pp 720-721 (05/1974).  
Trans. From: Izvestiya Vysshikh Uchebnykh Zavedenii Fizika 17,  
136-137 (May 1974)  
It has been shown that when a beam of fast electrons is injected  
into a gas-filled discharge gap, different types of volume or spark  
discharges can occur. The present paper describes the characteristics  
of a 250 kV spark discharge initiated by an electron beam. 6 Refs.  
Primary Keywords: Fast Electron Beam; Gas-filled Discharge Gap; 250 kV  
Spark Discharge; 1-20 mm Electrode Gap; 180 kV  
Maximum Electron Energy; 1-100 A Current Amplitude;  
5E-9 sec Current Pulse Length  
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6957  
(POWER CONDITIONING; POWER CONDITIONING)  
(Peaking Gaps, Saturated Reactors)  
SPARK PULSE PEAKING DEVICES WITH LOW SENSITIVITY TO PULSE HEIGHT  
G.A. Masvat  
Tomsk Polytechnic Institute, Tomsk, USSR  
Soviet Physics-Technical Physics, Vol. 10, No. 3, pp 400-402 (09/1965).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 35, 516-518 (March 1965)  
Peaking circuits are devices serving to narrow the wavefront of a  
pulse down to  $1E-9 - 1E-10$  sec, leaving the amplitude of the pulse  
unaffected. Spark-triggered peaking circuits and systems in which  
electromagnetic shock waves are generated are resorted to in the case  
of high-voltage pulses. The basic characteristics of peaking circuits  
are the duration of the pulse front at the output,  $t_{sub} f_2$ , the  
peaking efficiency  $k_{sub} eff$ ,  $t_{sub} f_1$  divided by  $t_{sub} f_2$  (where  
 $t_{sub} f_1$  is the duration of the front of the input pulse), the peak  
pulse amplitude  $U_{sub} max$ , the amplitude ratio  $k_{sub} ar = U_{sub} max$   
divided by  $U_{sub} min$ , and the peaking time  $t_{sub} p$  from the  
instant the pulse arrives at the peaking circuit till the appearance  
of the transformed pulse such that  $t_{sub} p < t_{sub} f_2$ . The values  
of  $t_{sub} f_2$  and of  $k_{sub} ar$  may attain  $1E-12$  sec and about 1E1  
sec, respectively, for both types of peaking circuits. 6 Refs.  
Primary Keywords: Spark Gap; For. etc. Pulse Amplitude Dependence; Size  
Considerations; Pulse Sharpening Efficiency  
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6960  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Gas, Electrical; Gas Gaps, Self)  
THE DIFFUSE AND CHANNEL STAGES IN THE OVERVOLTAGE BREAKDOWN OF A GAS GAP  
Yu.I. Bychkov, Yu.D. Korolev and V.M. Orlovskii  
Institute Of Atmospheric Optics, Academy of Sciences of the USSR,  
Moscow, USSR  
Soviet Physics Journal, Vol. 14, No. 9, pp 1198-1201 (09/1971).  
Trans. From: Izvestiya Vysshikh Uchebnykh Zavedenii Fizika 14, 45-49  
(September 1971)  
An interrupted discharge has been used to examine the production  
of light in the breakdown of an overvoltage gas gap in air under  
conditions of  $E_{ap} = 90-110$  W/cm<sup>2</sup> mm Hg. It is found that there are two  
types of discharge, the type being dependent on the number of initial  
electrons: diffuse when there are many electrons and of channel type  
when there is a single initiating electron. The observed voltage-fall  
curves for the first type of discharge agree well with theoretical  
ones derived from the avalanche theory. A study has been made of the  
dependence of the delay time and switching time on the relative  
intensity of the illumination used to produce the initial electrons.  
10 Refs.  
Primary Keywords: Gas Breakdown; Diffuse Breakdown; Spark Channel;  
Dependence On Initial Electron Number; Switching  
Delay  
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6961  
(ELECTROMAGNETIC FIELD GENERATION)  
(Magnetic)  
A NEW METHOD OF HIGH MAGNETIC FIELD GENERATION AND ITS APPLICATIONS  
M. Date  
Osaka University, Suita, Osaka, Japan  
IEEE Transactions On Magnetics, Vol. MAG-12, No. 6, pp 1024-1029  
(11/1976).  
A new method of generating high pulsed magnetic fields up to about  
1 MOe without destroying coils is described. The magnet consists of  
multi-layer coils which were designed so as to share the strong  
Maxwell stress within their tensile strength. A small 4-layer model  
magnet was tested and the maximum field of 1.07 MOe with the pulse  
width of 0.18 m sec. was obtained without destroying the coil. A  
three-year project of constructing a high magnetic field laboratory  
based on the new idea is proceeding in Osaka University. A 1.5 MJ  
energy source is used to produce up to 1 MOe within a volume of 20  
mm $\phi$  x 20 mm and low temperature experiments will be possible after  
two years. At present, however, the experiments at liquid helium  
temperature are limited up to 0.5 MOe. The submillimeter electron  
spin resonance experiments under the strong field were done using HCM  
and H/sub 2/O lasers and the determination of exchange constant  
between dissimilar spins was done. New terms, H/sub 2/ 2/ S/sub 2/ 2/  
H/sub 2/ 2/ S/ and H/sub 2/ 3/ 5 in the spin Hamiltonian are also  
discussed. Magnetization measurements in metals and compounds are  
reported. 21 Refs.  
Primary Keywords: Magnetic Field Generation; 1 MOe Field; Multiple  
Shot Coil; Multi-layer Coil; Stress Sharing;  
Materials Study  
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6965  
(ELECTROMAGNETIC FIELD GENERATION)  
(Magnetic)  
LIMITATIONS ON MAGNETIC FIELDS OBTAINED BY FLUX-COMPRESSION: I  
G. Lehner, J.G. Lihart and J.P. Somon  
Lab Gas Ionizzati, Euratom-CNEN, Frascati, Italy  
Nuclear Fusion, Vol. 4, No. 4, pp 362-379 (12/1964).  
The losses of a flux compression device are analyzed with the  
purpose of applying energy balance to estimate limits on magnetic  
field generation by flux compression. The two primary loss mechanisms  
considered are field diffusion and liner heating. 20 Refs.  
Primary Keywords: Magnetic Field Generation; Flux Compression; Loss  
Mechanisms; Field Diffusion; Liner Heating; Field  
Strength Limitation  
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6968  
(ELECTROMAGNETIC FIELD GENERATION)  
(Magnetic)  
PRODUCTION AND USE OF HIGH TRANSIENT MAGNETIC FIELDS. II  
H.P. Furth (1), M.A. Levine (2) and R.W. Waniak (3)  
(1) University of California, CA  
(2) AFRL, Bedford, MA 01730  
(3) Massachusetts Institute of Technology, Cambridge, MA  
The Review Of Scientific Instruments, Vol. 28, No. 11, pp 949-958  
(11/1957)  
The transient containment of high magnetic energy densities in  
coils of various geometries is discussed. Inherent mechanical and  
thermal limitations are shown to apply to coils relying solely on the  
strength of materials. The usefulness of inertial effects is  
demonstrated. Instrumentation is described for producing 10  
microsecond range pulses of amplitude up to 1.6 megagauss in  
single-turn coils. Experimental observations document the appearance  
of 'saw effect' and Kruskal-Schwarzschild instabilities at very high  
fields. The limitations characteristic of conventional coils can be  
overcome in force-free geometries. The appropriate mathematics is  
developed and illustrated with practical examples. 22 Refs.  
Primary Keywords: Magnetic Field Generation; Coil Geometry; Coil  
Materials Strength; 10 Microsecond Pulse Length; 1.6  
MG Field Strength; Single Turn Coil  
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6978  
(DIAGNOSTICS AND INSTRUMENTATION)  
(B-field)  
TECHNIQUE FOR MEASURING MEGA-GAUSS MAGNETIC FIELDS USING ZEEMAN EFFECT  
M.B. Garn, R.S. Caird, D.B. Thomson and C.M. Fowler  
Los Alamos National Labs, Los Alamos, NM 87545  
The Review Of Scientific Instruments, Vol. 37, No. 6, pp 762-767  
(06/1966)  
Rapidly varying magnetic fields with peak values in the range from 1 to 5 MG are measured by use of sweeping image spectrographic method. Atomic spectral lines from an exploding wire light source situated in the experimental region are recorded as the magnetic field varies in a few microseconds from a moderate initial value of a few tens of kilogauss to the peak values. Field measurements are generally accurate to within 2-3% as determined by the consistency of measurements made from several different spectral lines. The sodium D lines and the indium 1 4102 Angstrom line have proven to be exceptionally useful for field determinations. The highest field determined to date by this method is 5.1 MG, corresponding to a measured separation of 164 Angstroms between the centers of the shorter and longer wavelength doublets which the Na/sub D/ lines assume in very high fields. The doublets, of approximately 4 Angstrom separation, are not themselves resolved. 9 Refs.  
Primary Keywords: Magnetic Field Measurement; Zeeman Effect; 5 MG Measurement Range; 3 Per Cent Accuracy; 164 Angstrom Split Separation  
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6971  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
'MINUS' PULSED, HIGH-CURRENT, NANOSECOND, ELECTRON ACCELERATOR  
I.B. Dzhelekov, G.E. Gladyshev, B.T. Plachenov, B.N. Pugechev, O.S. Sirotiyuk, Yu.V. Terent'ev, V.A. Rodichkin and K.I. Finkel'shteyn  
Leningrad Technological Institute, USSR  
Instruments And Experimental Techniques, Vol. 23, No. 2, pp 327-330  
(06/1975)  
Trans. From: Priroda i Tekhnika Eksperimenta 2, 38-40 (March-April 1975)  
A description is given of a high-current electron accelerator with an energy of 500 keV, a beam current of 7 kA, and a pulse duration of 5-7 nsec. The electrons, emitted from a multi-point cathode with an area of 20 x 200 mm, are accelerated in a vacuum diode gap. Titanium foil 50 micron thick serves as the anode. The double shaping line of the accelerator is charged from a pulse transformer. 2 Refs.  
Primary Keywords: E-beam Generation; 500 keV Beam Energy; 7kA Current; 5-7 nsec Beam Duration; Multi-point Cathode; Titanium Anode  
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6972  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
A GENERATOR PRODUCING NANOSECOND PULSES OF FAST ELECTRONS  
M.V. Beikin, V.V. Bogolyubov, V.I. Kolesov and L.N. Khudiyakova  
Instruments And Experimental Techniques, Vol. 18, No. 2, pp 341-343  
(06/1975)  
Trans. From: Priroda i Tekhnika Eksperimenta 2, 19-21 (March-April 1975)  
The principle of operation and the characteristics of a portable pulsed source of fast electrons are described. The generator is fabricated according to a circuit with recharging of a capacitor. An autoelectronic tube with a foil cathode, which is equipped with a beryllium window for release of the electron beam into the atmosphere, is used in the generator. The source creates electron pulses having a length of approximately 1.5 nsec at the half-height. The amplitude of the accelerating voltage is approximately 200 kV. The maximum electron current is at least 200 A. 5 Refs.  
Primary Keywords: E-beam Generation; Portable Apparatus; Autoelectronic Tube; Foil Cathode  
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6973  
(PULSE GENERATORS)  
(Spiral)  
A HELICAL PULSE-VOLTAGE GENERATOR  
A.B. Gerasimov, I.M. Roife, E.B. Serebunko and B.A. Stekol'nikov  
Scientific-Research Institute Of Electro-Physical Equipment, Leningrad, USSR  
Instruments And Experimental Techniques, No. 3, pp 819-821 (06/1975)  
Trans. From: Priroda i Tekhnika Eksperimenta 1, 161-165 (May-June 1975)  
The results are presented of a study of models of a spiral generator (SG). It is found that for certain values of the parameters the selection of the width of the stripline affects the SG efficiency. An empirical formula is presented for estimating the optimum number of turns of the spiral. The load characteristics of the SG are also presented, and the possibility is discussed of using a SG in laboratory practice. 1 Refs.  
Primary Keywords: Spiral Generator; Stripline Width; Efficiency; Design Considerations  
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6974  
(PULSE GENERATORS)  
(Trigger)  
A 20-CHANNEL GENERATOR OF HIGH-VOLTAGE PULSES  
P.S. Anan'in and A.P. Kashirin  
Tomsk Polytechnic Institute, Tomsk, USSR  
Instruments And Experimental Techniques, Vol. 23, No. 1, pp 119-121  
(02/1978)  
Trans. From: Priroda i Tekhnika Eksperimenta 1, 121-123 (January-February 1978)  
A 20-channel generator of high-voltage pulses operating on an unmatched load is described. The wave impedance of the channels is 50 ohm. The maximum amplitude of the pulses is up to 15 kV or 8 high-impedance load and 7.5 kV on a matched load. The pulse duration is 100 nsec with a front duration of 12 nsec; the delay introduced by the generator is 200 for 2.5 nsec. Compensation of the pulse being formed and isolation of the pulse reflected from the load are provided for in the monitoring systems. The parameters of the load can be characterized from the shape and amplitude of the reflected pulse. 3 Refs.  
Primary Keywords: Pulse Generator; 20 Channel Output; Fixed Delay; Load Characterization; 50 ohm Load; 7.5 kV Output  
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6975  
(PARTICLE BEAMS, ION)  
(Generation)  
ACCELERATION OF IONS FROM AN EXPLOSIVE-EMISSION PLASMA  
E.I. Logachev, G.E. Remnev and Yu.P. Usov  
Tomsk Polytechnic Institute, Tomsk, USSR  
Soviet Technical Physics Letters, Vol. 4, No. 11, pp 605-606 (11/1980).  
Trans. From: Pis'ma Zhurnal Tekhnicheskoi Fiziki 6, 1404-1406 (November 1980)  
Much progress has been achieved in recent years in the production of high-current beams of light ions with energies of a few hundred keV and power levels up to 1E12 W. In most cases the ion source has been the plasma produced when a discharge is produced along the surface of a hydrocarbon insulator by the accelerating-voltage pulse. Ions of intermediate mass, in particular, carbon ions, are accelerated during injection of plasma from an auxiliary plasma source into the accelerating gap. In this letter we report the results of the first experiments on the acceleration in a plane diode of ions from an explosive-emission plasma, which is produced by applying to the anode (the high-potential electrode) a negative-polarity pulse before the positive accelerating-voltage pulse. 6 Refs.  
Primary Keywords: Intense Ion Beam Production; Intermediate And Heavy Elements; Explosive-emission Plasma; Plasma Production  
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6975  
(BREAKDOWN STUDIES; SWITCHES, OPENING)  
(Exploding Wire; Explosive Fuses)  
CURRENT DIFFUSION IN CYLINDRICAL EXPLODING WIRES AND FUSES DURING MICROSECOND ELECTRICAL PULSES  
F.D. Bennett  
Army Research and Development Command, Aberdeen Proving Ground, MD 21005  
Journal Of Applied Physics, Vol. 42, No. 7, pp 2835-2839 (06/1971).  
Existing solutions to the diffusion equation for current in a cylindrical conductor are used to provide estimates of the nonuniformity of current density during typical wire explosions. These estimates are given in the form of inequalities which are then used to specify the conditions under which current distribution and heating effect can be considered uniform. 7 Refs.  
Primary Keywords: Exploding Wire; Current Density Nonuniformity; Diffusion Equation; Uniform Heating; Current Ramp Solution; Theory  
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6977  
(BREAKDOWN STUDIES)  
(Liquid; Electrical)  
BREAKDOWN OF WATER IN A SYSTEM WITH 'DIFFUSION' ELECTRODES  
V.V. Vorob'ev, V.A. Kapitonov, E.P. Kruglyakov and Yu.A. Tsaidulko  
Institute Of Nuclear Physics, Academy of Sciences of the USSR, Novosibirsk, USSR  
Soviet Physics-Technical Physics, Vol. 25, No. 5, pp 598-602 (05/1980).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 50, 993-999 (May 1980).  
Results are presented of experiments pertaining to breakdown of water in an interelectrode gap with conducting layers near the surface of the electrodes. The electric field strength in the gap varied up to approximately 1.5 MV/cm. The conducting layers shielded the electrodes, causing the electrical strength to increase over that of pure water by approximately fourfold. 9 Refs.  
Primary Keywords: Water Breakdown; 1.5 MV/cm Electric Field Strength; Conducting Layers; Uniform Magnetic Field; Diffusion Electrode  
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6978  
(BREAKDOWN STUDIES; SWITCHES, OPENING)  
(Exploding Wires; Explosive Fuses)  
CERTAIN FEATURES OF EXPLODING WIRES  
V.S. Sedoi  
Tomsk Polytechnic Institute, Tomsk, USSR  
Soviet Physics-Technical Physics, Vol. 21, No. 8, pp 983-985 (08/1976).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 46, 1707-1710 (August 1976).  
One of the remarkable properties of exploding wires is the rapid increase of resistance during the explosion. Because of this resistance increase exploding wires can be used as fast, high-voltage current breakers, as fuses, and in devices for shaping high-voltage pulses. The mechanism for the resistance increase and the characteristics of the wire during the destruction stage have not yet been established, and experimental work in this field is of both practical and scientific interest. In the present paper we report a continuation of the work of several other workers. We offer a quantitative description of the electrical characteristics of the explosion during the destruction stage: the input energy before the current pause and the height  $U_{sub 1/2}$  and length  $t_{sub 1/2}$  of the voltage pulse which arises during the rapid increase in the resistance. 11 Refs.  
Primary Keywords: Exploding Copper Wires; Rapid Resistance Increase; Destruction Stage Characteristics; Opening Switch; Input Energy; Current Pause  
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6979  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
CHARACTERISTICS OF A HOLLOW ELECTRON BEAM IN A MAGNETICALLY INSULATED DIODE  
S.V. Belin'mytnyev, S.P. Gugaev, V.I. Koshelev, G.A. Maslyats, G.S. Poroka, V.M. Sveshnikov, K.N. Sukhushin and M.M. Timofeev  
Soviet Technical Physics Letters, Vol. 4, No. 12, pp 582-583 (12/1978).  
Trans. From: Pis'ma Zhurnal Tekhnicheskoi Fiziki 4, 1438-1442 (December 1978)  
Foil-free diodes with magnetic insulation are frequently used to form hollow electron beams. In electron sources of this kind it is important to know whether the beam current is limited by the diode or by the transport system. The ratio of the beam current  $I_{sub b}$  to the maximum current for the transport system  $I_{sub max}$  determines the beam potential (or energy) in the drift volume. The authors report on experiments with a long-pulse, plasma cathode, magnetically insulated diode. Two geometries are considered: coaxial and end-free types. 9 Refs.  
Primary Keywords: E-beam Generation; Field Emission Diode; Magnetic Insulation; Coaxial Geometry; End-free Geometry  
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6980  
(BREAKDOWN STUDIES)  
(Gas, E-beam)  
CONDITIONS FOR THE MAINTENANCE OF THE CURRENT IN THE CATHODE LAYER OF A SEMI-SELF-MAINTAINING VOLUMETRIC DISCHARGE EXCITED BY AN ELECTRON BEAM  
Yu. D. Korolov (1), V. B. Ponomarev (2) and V. S. Synakh (2)  
(1) Academy of Sciences of the USSR, Tomsk, USSR  
(2) Novosibirsk, USSR  
Journal of Applied Mechanics And Technical Physics, Vol. 20, No. 1, pp 15-18 (02/1979).  
Trans. From: Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki 20, 21-25 (January-February 1979)  
The distribution of an electric field in a gas gap with the flow of a semi-self-maintaining discharge through the gap is characterized by the presence of pre-electrode regions with an increased intensity of the field and the column of the discharge, where the field is approximately homogeneous. With a small rate of generation of electron-ion pairs psi and small applied voltages  $U_{sub}$  or, there are strong screening conditions. Under these conditions shock ionization, as a rule, is insignificant. With high values of psi and  $U_{sub}$  or, the electrical field in the cathode region rises so much that the principal mechanism of the generation of charged particles can become shock ionization. Then, the processes in the cathode layer of a discharge excited by a beam and of a glow discharge are similar in many respects. Therefore, the use of methods of calculation developed for the investigation of a glow discharge has made it possible to obtain certain evaluations for the case of large currents. 7 Refs.  
Primary Keywords: Volume Discharge; Current Maintenance; Semi-self-maintaining; Shock Ionization; Cathode Layer Transformations; E-field Calculation  
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6981  
(POWER CONDITIONING)  
(Pulse Forming Lines)  
CORRECTION OF THE CHARACTERISTIC OF A SPARK COMMUTATOR WITH A HETEROGENEOUS SHAPING LINE  
B. M. Koval'chuk, V. V. Kremnev and G. A. Mesyats  
Scientific-Research Institute Of Nuclear Physics, Electronics, And Automation, USSR  
Instruments And Experimental Techniques, No. 6, pp 1409-1411 (12/1966).  
Trans. From: Pribury i Tekhnika Eksperimenta 6, 119-121 (November-December 1966)  
A formula is derived for the profile of a heterogeneous shaping line for pulse correction, under the assumption that the voltage decay across the commutator, which causes elevation of the pulse peak at the load, is practically independent of the impedance of the discharge circuit. The obtained relation is confirmed experimentally with 4-ohm strip lines at 5 kV. The characteristic impedance of the heterogeneous line varied from 2.8 to 4.1 ohm. 4 Refs.  
Primary Keywords: Heterogeneous Shaping Line; 2.8-4.1 Ohm Line Impedance; Spark Commutator; Strict Pulse Peak Current Stability; Strip Line  
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6982  
(PARTICLE BEAMS, ELECTRON; INSULATION, MAGNETIC)  
(Generation)  
CROSS-FIELD CURRENT FLOW IN A MAGNETICALLY INSULATED DIODE  
I. Z. Gleizer, M. Didenko, Yu. P. Usav, V. I. Tsvetkov and A. A. Shatanov  
Tomsk Polytechnic Institute, Tomsk, USSR  
Soviet Physics-Technical Physics, Vol. 25, No. 6, pp 760-762 (06/1980).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 50, 1323-1326 (June 1980)  
Magnetically insulated diodes are widely used for producing high-current electron beams and find application for generating powerful superhigh-frequency radiation of microsecond duration. In this paper we study the passage of current across the magnetic field in high-current magnetically insulated electron diodes in the microsecond range, where failure of the magnetic insulation can limit the pulse length. 9 Refs.  
Primary Keywords: Magnetic Insulation; Cross-field Current Flow; High-current Electron Beams; Magnetically Insulated Electron Diodes; Variable Pulse Length  
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6983  
(BREAKDOWN STUDIES)  
(Liquid, Electrical)  
DEVELOPMENT OF A DISCHARGE IN A LIQUID DIELECTRIC WITH RAMP FUNCTION VOLTAGE PULSES  
V. Ya. Ushakov  
Tomsk Polytechnic Institute, Tomsk, USSR  
Soviet Physics-Technical Physics, Vol. 10, No. 10, pp 1420-1423 (04/1965).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 35, 1844-1847 (October 1965)  
Earlier we have published preliminary results of an investigation of the breakdown of distilled water in the case of ramp-function voltage pulses of positive polarity. In the present article we describe the results of investigations of breakdown in pure transformer oil, ethyl alcohol, and distilled water ( $\rho_{30} \leq 5 \text{ ohm/cm}$ ) in a rod-plate electrode system, the rod having either positive or negative polarity. 7 Refs.  
Primary Keywords: Water Breakdown; Discharge Development; Ramp Function Voltage Pulses; Rod-plate Electrode System; Liquid Dielectric Breakdown; Ionization Process  
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6985  
(BREAKDOWN STUDIES; SWITCHES, CLOSING; SWITCHES, OPENING)  
(Gas, E-beam; Gas Gaps; E-beam; Gas Gaps; E-beam)  
DISCHARGE IN A HIGH-PRESSURE GAS, INITIATED BY A BEAM OF FAST ELECTRONS  
B. M. Koval'chuk, V. V. Kremnev, G. A. Mesyats and Yu. F. Potolitsyn  
Academy of Sciences of the USSR, Tomsk, USSR  
Journal of Applied Mechanics And Technical Physics, Vol. 12, No. 6, pp 803-809 (12/1971).  
Trans. From: Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki 6, 21-29 (November-December 1971)  
It has been shown that, to avoid forming a discharge channel in a high pressure gas, one must have many initiating electrons before the start of the discharge, distributed over the cathode or through the discharge gap volume. To achieve this Koval'chuk et al. proposed using a beam of fast electrons. The present paper presents results of investigation of a discharge in nitrogen at pressures up to 16 atm, initiated by a beam of electrons with an average energy of 100 to 350 keV. A channel-less type of discharge was obtained for voltages above 125 V and for switched currents of tens of kiloperes. This type of discharge has typically a specific absorbed power in the gas of the order of 1E7 to 1E9 W/cm. or more for a time of the order of 1E-8 sec. 7 Refs.  
Primary Keywords: Discharge Channel Formation; 100 To 350 keV Average Beam Energy; High-voltage Nanosecond Pulse Generator; 1E-8 sec Beam Duration; 3E-9 sec Current Rise Time  
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6986  
(BREAKDOWN STUDIES)  
(Liquid, Electrical)  
EFFECT OF THE INITIAL CONDITIONS ON THE DYNAMICS OF AN UNDERWATER SPARK. I. EFFECT OF THE PARAMETERS OF THE GENERATOR AND THE MEDIUM  
E. V. Krivitskii, V. D. Kustovskii and A. P. Slivinskii  
Planning And Design Bureau Of Electrohydraulics, Academy of Sciences of the Ukrainian SSR, Nikolaev, USSR  
Soviet Physics-Technical Physics, Vol. 25, No. 8, pp 993-998 (08/1980).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 50, 1705-1712 (August 1980)  
The dynamics of an underwater spark are investigated by using a numerical-analytical method. The system of equations for the channel, which consists of an equation for the discharge circuit and another for the internal energy balance in the discharge channel, are closed by using an experimentally established proportionality between the internal energy and the electrical conductivity of the plasma. Satisfactory agreement is obtained between the experimental and calculated curves for the current, resistance, and radius of the channel. The range of discharge conditions under which the system is valid is established. The channel dynamics are very sensitive to such initial conditions as the electrical conductivity of the plasma and the parameters of the discharge circuit. 9 Refs.  
Primary Keywords: Underwater Spark Dynamics; Plasma Conductivity; Discharge Circuit Parameters Established; Discharge Channel Energy Balance; Channel Current; Channel Resistance; Empirical Formula  
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6987  
(BREAKDOWN STUDIES)  
(Liquid, Electrical)  
EFFECT OF THE INITIAL CONDITIONS ON THE DYNAMICS OF AN UNDERWATER SPARK. II. EFFECT OF AN EXTERNAL SOURCE OF PUMP ENERGY  
E. V. Krivitskii, V. D. Kustovskii and A. P. Slivinskii  
Planning And Design Bureau Of Electrohydraulics, Academy of Sciences of the Ukrainian SSR, Nikolaev, USSR  
Soviet Physics-Technical Physics, Vol. 25, No. 8, pp 998-1000 (08/1980).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 50, 1713-1716 (August 1980)  
The effect of a source of pump energy on the dynamics of a pulsed underwater discharge is investigated. A system of equations, describing the dynamics of the underwater spark channel with a linear voltage drop is used. A numerical solution is obtained for this system. The electrical characteristics of different discharge conditions are determined. An additional source of pump energy has a strong effect on the electrical and hydrodynamic characteristics of the underwater spark channel. 1 Refs.  
Primary Keywords: Underwater Spark Dynamics; External Pump Energy Source; Maximum Electroacoustical Efficiency; Maximum Pulse Pressure; Constant Discharge-channel Length  
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6988  
(BREAKDOWN STUDIES)  
(Gas)  
EFFICIENCY OF ENERGY TRANSFER TO AN ELECTRODELESS HIGH-FREQUENCY DISCHARGE  
S. I. Andreev, M. P. Vanyukov, A. A. Egorova and B. M. Sokolov  
Soviet Physics-Technical Physics, Vol. 12, No. 7, pp 910-913 (01/1968).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 37, 1252-1257 (July 1967)  
The efficiency of energy transfer from an oscillatory circuit to a gas discharge occurring inside a quartz vessel which is located in the coil is considered. The investigation is carried out in inert gases for pressures of 10-100 Torr for various circuit parameters and dimensions of the plasma vessel. The experimental data are in good agreement with theory. 8 Refs.  
Primary Keywords: Gas Breakdown; RF Discharge; Quartz Vessel; Energy Transfer Efficiency  
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6989  
(BREAKDOWN STUDIES)  
(Solid, Electrical)  
ELECTRIC BREAKDOWN IN SOLID DIELECTRICS  
G. A. Vorob'ev and N. S. Nesmelov  
Leningrad Institute Of Automatic Control Systems And Radioelectronics, USSR  
Soviet Physics Journal, Vol. 22, No. 1, pp 70-80 (01/1979).  
Trans. From: Izvestiya Vysshikh Uchebnykh Zavedenii, Fizika 22, 90-104 (January 1979)  
It is known that three main forms of solid-dielectric breakdown may be distinguished: 1) electrothermal; 2) electrical; 3) electrochemical. The laws of electrothermal and electrochemical breakdown are required for the design and construction of power-station insulation. The laws of electrical breakdown are important in constructing the insulation of equipment for the application of a pulsed load. In addition, in the case of electrical breakdown, it is usual to consider the interaction of electrons with a solid structure, and therefore the laws of electrical breakdown give certain information on the solid structure. It is now half a century since the first scientific hypotheses appeared, but much work remains to be done on dielectric breakdown. Various explanations of breakdown have been proposed. These explanations have been given in many monographs and reviews and there is no point in repeating them here. It is sufficient to note that over the last 30 years theoreticians have tended to the view that the electrical breakdown of solid dielectrics is due to impact ionization by electrons and that the theory must be based on the solution of the kinetic equations. There is definite interest in giving an account for all these processes within the scope of a single paper, which has not been done before. 85 Refs.  
Primary Keywords: Solid-dielectric Breakdown; Electrothermal; Electrical; Electrochemical; Impact Ionization; Prebreakdown Phenomena  
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6990

## (BREAKDOWN STUDIES)

(Liquid, Electrical)

## ELECTRICAL CHARACTERISTICS OF A SPARK DISCHARGE IN A CIRCULATING TRANSFORMER OIL

G.S. Korshunov, G.A. Kisilev and Yu.B. Fortes

Applied Electrical Phenomena, No. 4 (28), pp 282-286 (08/1969).  
Trans. From: Elektronnaya Obrabotka Materialov 4, 41-46 (July-August 1969)

At the present time gas-filled and vacuum-type peaked spark dischargers of various constructions are widely used as sources of high-voltage, sharp-fronted pulses. This is largely because the working medium of such dischargers has a sufficiently long-term stability when subjected to the effects of the electrical discharges occurring periodically between the electrodes. For this reason the electric field strength in the gap remains nearly constant from breakdown to breakdown; to a large extent this makes possible the stabilization of the parameters set up during the peaking of the high-voltage pulses. 6 Refs.

Primary Keywords: Oil Breakdown; Circulating Transformer Oil; Peaking Discharger; Stable Voltage Pulse Parameters; Almost Constant Breakdown Characteristics; Good High Frequency Operation; Minimal Energy Losses

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## (BREAKDOWN STUDIES)

(Liquid, Electrical)

## ELECTRICAL CONDUCTION AND DEVELOPMENT OF BREAKDOWN IN LIQUID DIELECTRICS

V.Ya. Ushakov

Tomsk Polytechnic Institute, Tomsk, USSR

Soviet Physics Journal, Vol. 22, No. 1, pp 81-94 (01/1979).  
Trans. From: Izvestiya Vysishikh Uchebnykh Zavedenii, Fizika 22, 105-121 (January 1979)

The development of electrical power, associated with increase in the volume of power transmission, in operational stress levels, and in the power and reliability of individual units, imposes ever more stringent requirements on electrical engineering materials and, in particular, on insulating materials. The high electrical strength of insulating liquids, their good heat-conduction and arc-suppression properties, their technological convenience, their cheapness, and their self-repair after breakdown—these and a whole series of other qualities are responsible for the wide use of liquids as insulation in high-voltage equipment. The rapid increase in the electrical strength of liquids with decrease in the time of application of the potential and the high dielectric permittivity of most insulating liquids, in combination with the properties already noted, mean that they provide an irreplaceable insulating medium in accumulator and line-forming generators of high-voltage pulses, which, as is known, have been widely used in recent years to obtain powerful beams of relativistic electrons, giant x-ray scintillations, strong pulsed electromagnetic fields, etc. Because of restrictions of space, the present work deals extremely briefly with some aspects of liquid dielectric conduction and breakdown, while no consideration at all is given to others. 80 Refs.

Primary Keywords: Weak Electrolytes; Electrical Conduction; Breakdown Development; Liquid Dielectrics; Strong Electric Field; Ionization

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## (BREAKDOWN STUDIES)

(Solid, Electrical)

## ENERGY BALANCE FOR A SPARK IN A SOLID DIELECTRIC

M.T. Zinov'ev and B.V. Semkin

Tomsk Polytechnic Institute, Tomsk, USSR

Soviet Physics-Technical Physics, Vol. 23, No. 3, pp 369-370 (03/1978).

Trans. From: Zhurnal Tekhnicheskoi Fiziki 48, 624-626 (March 1978)

In the boundary-value problem associated with the properties of the flow around an expanding spark in a condensed dielectric the boundary condition is incorporated in the energy-balance equation for the spark channel. For a 'buried' discharge in a solid dielectric, in which case measures are taken to prevent the products produced in the spark channel from escaping into the ambient medium, the energy-balance equation contains only three terms (in a first approximation), by analogy with discharges in liquids. The authors compare experimental results to those obtained with the proposed breakdown model. 8 Refs.

Primary Keywords: Solid Dielectric; Energy-balance Equation; Spark Channel; Boundary Condition; 3000 pF Discharge Capacitance; 9 Microhenry Circuit Inductance; Theory; Comparison With Experiment; Plexiglas

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6997

## (BREAKDOWN STUDIES)

(Gas, E-beam)

## EXTERNALLY MAINTAINED DISCHARGE WITH A GASDYNAMIC WINDOW FOR A LOW-ENERGY ELECTRON BEAM

Yu.I. Bychkov, Yu.D. Korolev, G.A. Mesyats, D.A. Moskov, V.V. Osipov,

L.M. Orlikov, A.G. Filonov and E.V. Chikin

Soviet Technical Physics Letters, Vol. 4, No. 5, pp 206-207 (05/1978).

Trans. From: Zhurnal Tekhnicheskoi Fiziki 4, 515-518 (May 1978)

Systems in which fast electron beams are used to excite volume discharges generally include an accelerator with an exit window made of a thin foil, which isolates the accelerating gap from the gas-filled gap and which isolates the discharge cell with its power supply. This exit window complicates the design and operation of the system because it tends to fail in cw operation; moreover, the electrons must be accelerated to high energies in order to pass through the window without losing energy (high-energy electrons are not the optimum choice for ionizing the gas because the ionization cross section decreases with increasing energy). In this letter we report the first results on the use of a special accelerator with a gasdynamic window for the excitation of a volume discharge. 7 Refs.

Primary Keywords: Volume Discharge; E-beam Sustained; Gas Dynamic Window; Low Loss; Glow Discharge

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6998

## (BREAKDOWN STUDIES)

(Vacuum, Electrical)

## FORMATION OF A HIGH-CURRENT VACUUM SPARK BY THE HIGH-SPEED INTERFEROMETRY METHOD

S.P. Bugayev, R.B. Bakshi, E.A. Litvinov and V.P. Stashev

Institute of Atmospheric Optics, Academy of Sciences of the USSR,

Moscow, USSR

High Temperature, Vol. 14, No. 6, pp 1027-1032 (12/1976).

Trans. From: Izvestiya Vysishikh Uchebnykh Zavedenii, Fizika 22, 1145-1150 (November-December 1976)

This article gives the results of an investigation of the distribution of the electron concentration in a vacuum spark with a duration of 100 nsec, with a current of 4 kA and an interelectrode distance of 0.7 mm. The work was carried out using a Michelson interferometer with a spatial resolution of 30 micron. It is shown that the maximal concentration is attained at the anode in the final phase of the discharge, and amounts to  $1E19$  cu.cm. 8 Refs.

Primary Keywords: High-current Vacuum Spark; Electron Concentration Distribution; 100 ns Spark Duration; 4 kA Current; 0.7 mm Interelectrode Distance;  $1E19$  cu.cm. Maximal Concentration; Anode And Cathode Flares; Michelson Interferometer

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## (BREAKDOWN STUDIES)

(Liquid, Electrical)

## FORMATION OF ELECTRICAL BREAKDOWN IN AQUEOUS SODIUM CHLORIDE SOLUTIONS

N.P. Mal'nikov, G.A. Ostrovov and M.Yu. Stoyak

A.A. Zhdanov Leningrad State University, Leningrad, USSR

Soviet Physics-Technical Physics, Vol. 9, No. 5, pp 730-733 (11/1964).

Trans. From: Zhurnal Tekhnicheskoi Fiziki 34, 949-951 (May 1964)

A high-speed SFR-2M camera has been used to refine some previous results, obtain new data on the rate at which the discharge channel and its gas envelope develop, and follow the development of shock waves (spherical and cylindrical). 2 Refs.

Primary Keywords: Electrolyte Breakdown; NaCl Solution; Photographic

Agonistic; Spark Channel; Gas Envelope; Shock Wave

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7000

## (BREAKDOWN STUDIES; SWITCHES, CLOSING)

(Electrodes; Vacuum Gaps, Electrical)

## FORMATION OF NEW EMISSION CENTERS ON A CATHODE DURING CURRENT SWITCHING

D.I. Proskurovskii and V.F. Puchkarov

Academy of Sciences of the USSR, Tomsk, USSR

Soviet Physics-Technical Physics, Vol. 24, No. 12, pp 1474-1478 (12/1979).

Trans. From: Zhurnal Tekhnicheskoi Fiziki 49, 2611-2618 (December 1979)

The conditions prevailing in the cathode sheath are analyzed. It is shown that the formation of new emission centers below the plasma of the cathode spot by a mechanism involving explosion of microscopic fine tips can occur at distances approximately  $1E-4$  cm from the primary emission center, while a mechanism involving the breakdown of nonmetallic inclusions and films on the cathode can explain the formation of new emission centers at distances out to  $1E-2$  cm. The appearance of emission centers on a narrow probe separated from the point of ignition on the cathode by a distance of  $4E-3 - 1.2$  cm is studied in the spark and arc stages of a vacuum discharge. The experimental results can be explained well by the second mechanism for the formation of new emission centers. 30 Refs.

Primary Keywords: Current Switching; New Emission Center Formation; Microscopic Fine Tip Explosions; Cathode Spots; Cathode Potential Drop Increase; Cathode Inclusions; Cathode Film

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7001

## (BREAKDOWN STUDIES; SWITCHES, CLOSING)

(Vacuum, Electrical; Vacuum Gaps, Electrical)

## FORMATION OF NEW EMISSION CENTERS ON A CATHODE DURING CURRENT SWITCHING

D.I. Puchkarov and V.F. Proskurovskii

Academy of Sciences of the USSR, Tomsk, USSR

Soviet Physics-Technical Physics, Vol. 24, No. 12, pp 1479-1481 (12/1979).

Trans. From: Zhurnal Tekhnicheskoi Fiziki 49, 2619-2622 (December 1979)

The results derived in part I of this work are used to show that nonmetallic inclusions and films on the cathode determine the nature and velocity of the rapidly moving cathode spots, the nature of the cathode erosion in nanosecond vacuum discharges, the spontaneous appearance of new cathode spots in vacuum sparks, and the appearance of cathode spots and moving double layers in 'straight-discharge' devices. 14 Refs.

Primary Keywords: Vacuum Breakdown; Experimental Confirmation; Nonmetallic Inclusions And Films; Cathode Spot Appearance; Cathode Spot Motion

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7003

## (BREAKDOWN STUDIES)

(Vacuum, Electrical)

## FORMATION OF PLASMA CHANNEL BY A VACUUM SPARK

R.B. Bakshi, B.A. Koshlambaev and N.A. Ratakhin

Academy of Sciences of the USSR, Tomsk, USSR

Soviet Physics-Technical Physics, Vol. 25, No. 6, pp 779-780 (06/1980).

Trans. From: Zhurnal Tekhnicheskoi Fiziki 50, 1350-1351 (June 1980)

In recent years there has been growing interest in processes which occur in the plasma of a vacuum spark in connection with the discovery that such plasma contains high-temperature regions, dubbed 'plasma points'. The initial phase in the formation of a plasma point follows immediately after vacuum breakdown, and the transition from a weakly ionized metal vapor to a plasma with classical conduction is of unquestionable interest for the study of this effect. In the present paper Thomson scattering was used to study the plasma of a pulsed vacuum spark, induced in a two-electrode apparatus with an igniting device, an apparatus such as is usually employed in investigations of this kind. 5 Refs.

Primary Keywords: Vacuum Breakdown; Plasma Channel Formation; Plasma Points; Thomson Scattering; Pulsed Vacuum Spark; Electron Density Distribution; Spark Channel Temperature

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7004  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
FORMATION OF THE SPARK CHANNEL AND CATHODE SPOT IN A PULSED VOLUME DISCHARGE  
R.B. Bakst, Yu.D. Korolev and G.A. Mesyats  
Academy of Sciences of the USSR, Tomsk, USSR  
Soviet Journal of Plasma Physics, Vol. 3, No. 3, pp 369-371 (06/1977).  
Trans. From: Fiz. Plazmy 3, 652-656 (May-June 1977).  
The formation of the cathode spot was studied in a nanosecond volume discharge in an atmosphere of industrial-grade nitrogen at a pressure of 50-100 Torr. The electrode separation was 1 cm, and the height of the voltage pulse applied to the electrodes was 10-30 kV. Spectrograms and photographs of the emission of the discharge in various stages are shown. Photoelectric detection of the spectral lines of atomic copper was used to determine the time at which the cathode spot appears. The formation of the cathode spot is shown to be preceded by the appearance of diffuse channels with a relatively high current density. These channels lead to an increase in the electric field at the cathode and to a subsequent explosion of microsecond protrusions on the cathode. 12 Refs.  
Primary Keywords: Spark Channel Formation; Cathode Spot; Nanosecond Volume Discharge; 50-100 Torr Pressure Nitrogen; 1 cm Electrode Separation; 10-30 kV Pulse Height  
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7006  
(BREAKDOWN STUDIES)  
(Liquid, Electrical)  
FORMATION IN LIQUID IN INITIAL STAGES OF A PULSED DISCHARGE  
V.Ye. Lopyatin and V.M. Muratov  
Tomsk Polytechnic Institute, Tomsk, USSR  
Soviet Physics Letters, Vol. 15, No. 21, pp 1568-1572 (11/1972).  
Trans. From: Izvestiya Vysshikh Uchebnykh Zavedeniy, Fizika 15, 42-47 (November-December 1972).  
Discharge formation in electrolytes with gamma-IE-2 - IE-4 ohm cm, dielectric water gamma-IE-2 - 1.5E-6 ohm cm, and chemically pure hexane in the initial stages of formation of discharge with rectangular voltage pulses of 0.67 and 1.85 microsecond duration is investigated. The experimental results are compared with the results of approximate calculations. 13 Refs.  
Primary Keywords: Liquid Breakdown; Electrolyte Breakdown; Gas Breakdown; Pulsed Discharge Channel Formation; High Electric Conductivity; Experimental Theory  
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7007  
(PULSE GENERATORS)  
(Pulse Forming Lines)  
GENERATOR OF HIGH-VOLTAGE RECTANGULAR PULSES  
M.U. Bulatov, B.K. Toropov, V.G. Filippov and E.M. Chernov  
Instruments and Experimental Techniques, Vol. 22, No. 6, pp 1589-1591 (12/1979).  
Trans. From: Priroda i Tekhnika Eksperimenta 6, 101-103 (November-December 1979).  
A generator of high-voltage rectangular pulses, built in the form of four series-connected, 10-element, two-stage shaping lines (TSL), is described. Each TSL is switched by a multigap discharger controlled by a spiral generator. The triggering range of the discharger is 80%. The maximum load voltage is 320 kV, the pulse duration is 20 microseconds, the current is 10 kA, and the irregularity of the top of a pulse is  $\leq 1-2\%$ . 7 Refs.  
Primary Keywords: Pulse Generator; Pulse Shaping Line; Rectangular Output; Spiral Generator; 320 kV Output Voltage;  $\leq 2\%$  Droop  
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7009  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
IMPROVED STABILITY OF EXPLOSIVE-EMISSION MULTIPLE-TIP CATHODES  
V.A. Burtsev, M.A. Vasilevskii, I.M. Roife, E.V. Seredenko and V.I. Engel'ko  
Soviet Technical Physics Letters, Vol. 4, No. 9, pp 436-437 (09/1978).  
Trans. From: Pisma Zhurnal Tekhnicheskoi Fiziki 4, 1083-1087 (September 1978).  
Bazhenov et al. have shown that explosive-emission cathodes can be used to produce electron-current pulses approximately 1E-4 sec long. Comparable pulse lengths are achieved elsewhere with multiple-tip cathodes. However, the operation of a diode with an explosive-emission cathode in a long current pulse has certain characteristics that can restrict the practical use of these diodes. For example, the electron current fluctuates; the number of working tips decreases at low diode voltages; and the operation of the diode can be unstable. To study the factors responsible for these effects, we have carried out experiments with a multiple explosive-emission cathode. The emitters are bundles of graphite fibers; in the present experiments these fibers are attached to the metal substrate through insulators. 3 Refs.  
Primary Keywords: E-beam Generation; Multiple Cathode; Explosive Emission; 1E-4 sec Pulse Length; Guard Electrode  
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7010  
(BREAKDOWN STUDIES)  
(Liquid, Electrical)  
INITIATION AND DEVELOPMENT OF NANOSECOND DISCHARGES IN LIQUIDS  
V.V. Lopatin, V.Ye. Ushakov and V.P. Chernenko  
Tomsk Polytechnic Institute, Tomsk, USSR  
Soviet Physics Journal, Vol. 18, No. 3, pp 376-381 (03/1975).  
Trans. From: Izvestiya Vysshikh Uchebnykh Zavedeniy, Fizika 18, 100-106 (March 1975).  
The initiation and development of discharges in purified water and hexane were studied for pulse rise times of  $t_{sub}$  of approximately 2-3 nsec and pulse lengths of  $t_{sub}$  of approximately 10-50 nsec by an oscilloscopic method and with an electron-optical image converter. The results are compared with data on the nanosecond breakdown of gases. A physical interpretation is offered for the observed behavior. 13 Refs.  
Primary Keywords: Liquid Breakdown; Purified Water; 2-3 nsec Pulse Rise Times; 10-50 nsec Pulse Lengths; Pulsed Electrical Breakdown; Discharge Development; Pure Hexane; 400 kV Pulse Amplitude; Point-plane Electrode System  
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7011  
(BREAKDOWN STUDIES)  
(Gas, RF)  
INVESTIGATION OF THE ENERGY TRANSFER EFFICIENCY FOR A PULSED INDUCTION DISCHARGE  
S.I. Andreev, O.G. Baikov, P.N. Dashuk, E.A. Sergeenkov and M.D. Yaryeva  
Soviet Physics-Technical Physics, Vol. 14, No. 6, pp 774-778 (12/1969).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 39, 1032-1038 (June 1969).  
An investigation was carried out of the energy transfer efficiency for a noninductive capacitor discharge at conditions near the upper limit of rate of current increase in xenon, argon, and neon plasmas. It was found that the most efficient energy transfer to the plasma (of the order of 80%) occurs when multiturn exciting solenoids are used, and takes place under conditions of high plasma conductivity as determined by its temperature. The temperature reached 25,000 Deg.K. for a xenon discharge at pressures from 2 to 50 Torr. Data are presented for the relative spectral radiant energy distribution. 19 Refs.  
Primary Keywords: Gas Breakdown; Neon; Argon; Xenon; Energy Transfer Efficiency; Multiturn Solenoid  
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7012  
(BREAKDOWN STUDIES)  
(Solid, Electrical)  
MECHANICAL ASPECTS OF THE ELECTRICAL BREAKDOWN OF SOLID DIELECTRICS  
B.V. Semkin and V.S. Korolev  
Tomsk Polytechnic Institute, Tomsk, USSR  
Soviet Physics Journal, Vol. 15, No. 6, pp 1348-1350 (09/1972).  
Trans. From: Izvestiya Vysshikh Uchebnykh Zavedeniy, Fizika 15, 107-110 (September 1972).  
The possibility of mechanical failure of a solid dielectric due to compressive forces being the first cause of its impulse electrical breakdown has been studied on a number of occasions. It was shown that the mechanical stresses in dielectrics in an electric field of the order of 1 MV/cm are considerable, and in a number of cases are sufficient for the failure of the material. However, so far the hypothesis of the mechanical failure of dielectrics due to field forces have not been substantiated experimentally. 10 Refs.  
Primary Keywords: Dielectric Breakdown; Mechanical Stresses; Point-plane Electrode Field; Crack-formation; Incomplete Breakdown Channels; Ponderomotive Force  
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7014  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
MICROSECOND HIGH-CURRENT ELECTRON-BEAM ACCELERATOR  
V.A. Burtsev, M.A. Vasilevskii, O.A. Gusev, I.M. Roife, E.V. Seredenko and V.I. Engel'ko  
Instruments and Experimental Techniques, Vol. 22, No. 5, pp 1223-1226 (10/1979).  
Trans. From: Priroda i Tekhnika Eksperimenta 5, 32-35 (September-October 1979).  
The main constructional and physical characteristics of a high-current electron accelerator with energy of approximately 0.5 MeV, current of approximately 5 kA and current pulse length of approximately 10 microseconds are given. 6 Refs.  
Primary Keywords: E-beam Generation; 0.5 MeV Energy; 5 kA Current; 10 Microsecond Beam Duration; Magnetic Insulation; Cathode Plasma  
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7016  
(BREAKDOWN STUDIES; INSULATION, MATERIAL)  
(Solid, Electrical; Solid)  
NANOSECOND BREAKDOWN OF POLYMERS  
G.A. Vorob'ev and V.S. Korolev  
Academy of Sciences of the USSR, Tomsk, USSR  
Soviet Physics-Technical Physics, Vol. 21, No. 10, pp 1222-1225 (10/1976).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 46, 2088-2093 (October 1976).  
Nanosecond breakdown is studied for several polymers: polyethylene, polystyrene, polymethyl methacrylate, polyvinyl chloride, nylon-6, and teflon. 7 Refs.  
Primary Keywords: Nanosecond Breakdown; Several Polymers; Homogeneous Field; Dielectric Strength; Inhomogeneous Field; Point-plane Electrode System; Polarity Effect; Cathode Plasma; Impact Ionization  
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7017  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
NANOSECOND GAS DISCHARGE IN AN INHOMOGENEOUS FIELD WITH EXPLOSIVE PROCESSES ON THE ELECTRODES  
Yu.D. Korolev, V.A. Kuz'min and G.A. Mesyats  
Academy of Sciences of the USSR, Tomsk, USSR  
Soviet Physics-Technical Physics, Vol. 25, No. 1, pp 418-420 (04/1980).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 50, 699-704 (April 1980).  
Air breakdown at pressures 20-500 Torr was investigated in a needle-and-plane electrode configuration with rectangular voltage pulses applied to the gap. Depending on the needle tip polarity, a cathode or anode spot is produced during the first few nanoseconds and the discharge burns in the form of a diffuse channel with a spot on the tip electrode. The contraction process is connected with the growth of spark channels from the cathode and anode spots. 11 Refs.  
Primary Keywords: 20-500 Torr Pressures; Air Breakdown; Needle-and-plane Electrode Configuration; Spark Channels; Cathode And Anode Spots; Nonuniform Field; Tip Electrode; Dark Cathode Potential-drop Region  
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7018

(BREAKDOWN STUDIES)  
(Gas, Electrical)

## PREBREAKDOWN PROCESSES IN HIGH-PRESSURE GASES

I.M. Bortnik  
All-Union Institute, Moscow, USSR  
Soviet Physics Technical Physics, Vol. 23, No. 2, pp 156-160 (02/1978).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 48, 259-265 (February 1978).  
A current of  $10^{-11}$  -  $10^{-5}$  A flows through the gap at high gas pressures in a homogeneous field with field intensities well below the breakdown level. Analysis of this current as a function of the gap properties in special experiments shows it results from ionization processes which occur in the local fields near microscopic inhomogeneities of the electrodes. These ionization processes lead to a breakdown of the entire gap or to a self-sustained discharge which is limited by its own space charge. The qualitative and quantitative features of the evolution of the total breakdown of the gap from a localized breakdown agree with the behavior observed for prebreakdown effects in a homogeneous field in a high-pressure gas. On this basis a qualitative picture of the evolution of a high-pressure discharge is given. Appropriate topics for further study are identified. 2 Refs.

Primary Keywords: Prebreakdown Current; High-pressure Gases;  $10^{-11}$  -  $10^{-5}$  A Currents; Homogeneous Field; Ionization Processes.

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7019

(BREAKDOWN STUDIES)  
(Gas, E-beam)PROPERTIES OF A SPACE DISCHARGE EXCITED BY AN ELECTRON BEAM OF  $10^{-4}$  SEC DURATION

Yu.I. Bychkov, S.A. Gorkin, Yu.D. Kornilov, Yu.F. Kraindol, G.A. Kuznetsov and A.G. Mesyats  
Institute Of Atmospheric Optics, Academy of Sciences of the USSR, Moscow, USSR  
Soviet Physics JETP, Vol. 19, No. 2, pp 299-300 (08/1974).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 40, 422-425 (February 1974).

A space discharge maintained by a fast-electron beam of  $10^{-4}$  sec duration in a mixture of noble gases characterized in this paper. The discharge is excited at different pressures and ratios of energy delivery to the discharge volume. The conditions are found for which the space discharge is stable (does not become a spark discharge). 6 Refs.

Primary Keywords: Space Discharge;  $10^{-4}$  sec Duration; Fast-electron Beam; Stable Sparkless Discharge Regime; 250 kV; Volt Amplitude.

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7020

(BREAKDOWN STUDIES; SWITCHES; CLOSING)

(Gas, Electrical; Gas Gaps, Self)

## STABILIZATION OF IGNITION VOLTAGE IN HIGH-PRESSURE SPARKS

N.V. Belkin and E.A. Avilov  
Soviet Physics Technical Physics, Vol. 16, No. 10, pp 1717-1719 (10/1972).

Trans. From: Zhurnal Tekhnicheskoi Fiziki 41, 2167-2169 (October 1972).  
Voltage stabilization of pulsed gaps at high values of pd is considered. In two-electrode gaps 1 to 2 mm long at a pressure of up to 40 atm it is possible to reduce the spread in ignition voltage by a factor of 3. If the surface of the cathode electrode has a large number of inhomogeneities as whose height is 10 to 15% of the gap width. 8 Refs.

Primary Keywords: Self-breakdown Spark Gaps; High pd; 40 atm Pressure; 2 mm Gap Distance; Cathode Structure; Jitter.

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7021

(BREAKDOWN STUDIES; INSULATION; MATERIAL)

(Liquid, Electrical; Liquid)

## STUDY OF THE PULSE ELECTRICAL STRENGTH OF SOME LIQUIDS

N.S. Rudenko and V.I. Tsvetkov  
Tomsk Polytechnic Institute, Tomsk, USSR  
Soviet Physics Technical Physics, Vol. 16, No. 10, pp 1717-1719 (10/1972).

Trans. From: Zhurnal Tekhnicheskoi Fiziki 41, 2167-2169 (October 1972).  
Relatively large capacitors (100-1000 pF) with a high intrinsic inductance (10-100 nH) are used to study the pulse electrical strength of some liquids. It is shown that the high-voltage pulse width is a function of the liquid properties. It is desirable to know as the discharge time as the high voltage is constant. In the present article, a quantitative analysis is given of the results of the study of the pulse electrical strength of some liquids with large dielectric constants. The results of the study of the pulse electrical strength of some liquids with large dielectric constants are given. 11 Refs.

Primary Keywords: Liquid Dielectric Constant; Voltage; Pulse Width; High Voltage; Pulse Width; Liquid Properties; Intrinsic Inductance; Capacitors; Dielectric Constant; Pulse Electrical Strength; Liquid Properties.

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7022

(BREAKDOWN STUDIES)

(Vacuum, Electrical)

## THE CATHODE DURING VACUUM BREAKDOWN

V.A. Nevroskil and V.I. Zakharenko  
All-Union Institute, Moscow, USSR  
Soviet Physics Technical Physics, Vol. 25, No. 10, pp 1239-1244 (10/1980).

Trans. From: Zhurnal Tekhnicheskoi Fiziki 50, 2127-2135 (October 1980).  
The heating of a cathode surface during vacuum breakdown is studied. It is shown that the electron emission from the cathode is a function of the cathode temperature. It is proposed to use the cathode temperature as a criterion for the onset of vacuum breakdown. It is shown that the cathode temperature is a function of the cathode material and the cathode geometry. The results of the study of the cathode temperature during vacuum breakdown are given. 11 Refs.

Primary Keywords: Cathode Temperature; Vacuum Breakdown; Cathode Material; Cathode Geometry; Cathode Temperature; Vacuum Breakdown; Cathode Material; Cathode Geometry.

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7023

(BREAKDOWN STUDIES)  
(Gas, Electrical)

## BREAKDOWN OF THE NEAR-ELECTRODE LAYER IN A FLOW OF IONIZED GAS

G.A. Lyubimov  
Journal Of Applied Mechanics And Technical Physics, Vol. 14, No. 3, pp 397-402 (07/1973).  
Trans. From: Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki 14, 16-23 (May-June 1973).

An electric discharge in a flow of ionized gas is widely used in many physics and engineering problems. Among them are problems associated with current flow in various magnetohydrodynamic devices (generators, accelerators), arc shunting in plasmatron, physical experiments in shock tubes, etc. It is known that with cold electrodes providing the contact between the plasma and the external circuit, for relatively high pressures, two modes of current flow occur: the discharge abruptly shifts into a discharge with a clearly developed cathode spot at some critical current density (we call this form of discharge an arc discharge). Existing experimental data refers to varying experimental conditions. Furthermore, the critical voltage for currents at which the transit of the discharge from a diffuse discharge to an arc discharge occurs varies within very broad limits. From an analysis of the experimental data, a condition is formulated which the discharge parameters satisfy at the time of transition from a diffuse discharge to an arc discharge. 26 Refs.

Primary Keywords: Gas Discharge; Hot Plasma Core; Cold Wall Gases; Low Current; Diffuse Discharge; High Current; Spark Discharge; Emergent Formulas.

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7024

(ELECTROMAGNETIC FIELD GENERATION)

(Liquid)

## COMPRESSION OF A MAGNETIC FIELD BY A CYLINDRICAL CONDUCTING BLANKET OF FLUID

N.I. Akhmetov and A.P. Kuznetsov  
Magnetohydrodynamics, Vol. 4, No. 4, pp 85-87 (12/1962).  
Trans. From: Magnitnaya Gidrodinamika 4, 124-128 (1962).

At present, the literature contains a considerable number of studies devoted to various problems in the theory and use of high-strength magnetic fields. The operation of these generators is based on the fact that the magnetic flux is compressed by a hollow metal cylinder. In this study an attempt is made to analyze the compression of a cylinder with a magnetic flux inside it. The authors consider the compression of a magnetic flux by an axisymmetric, infinitely long, cylindrical conducting blanket of fluid. In addition, the penetration of the latter by a magnetic field owing to conductivity of the blanket of fluid is examined. The solutions allow for the effect of thickening of the blanket during its compression. 12 Refs.

Primary Keywords: Flux Compression; Liquid Shell; Cylindrical Geometry; Infinite Length; Finite Conductivity; Blanket Deformation.

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7025

(BREAKDOWN STUDIES; SWITCHES; CLOSING)

(Liquid, Electrical; Liquid Gaps, Self)

## CONTROLLED DISCHARGE IN A LIQUID

V.K. Bratsky and S.A. Smirnov  
Soviet Physics Technical Physics, Vol. 19, No. 10, pp 1589-1592 (10/1973).

Trans. From: Zhurnal Tekhnicheskoi Fiziki 43, 1714-1718 (October 1973).

The results are reported of an experimental investigation of the breakdown of technical water by a trigger spark at the surface of one of the electrodes of the main discharge gap in the liquid. It is shown that a trigger spark can be used to trigger the discharge between the electrodes of the main gap. The trigger spark has the greatest effect on breakdown in water when the voltage is applied to the main gap a certain time after the instant of breakdown of the trigger gap. It is shown that the maximum discharge current, the smallest breakdown voltage and the trigger voltage at which spark breakdown of the gap can occur, the effect of the trigger spark is not seen when the energy dissipated in it is increased. 11 Refs.

Primary Keywords: Water Breakdown; Technical Water; Trigger; Trigger Spark; Spark Discharge; Liquid; Optimalization.

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7026

(BREAKDOWN STUDIES)

(Liquid, Electrical)

## NATURALLY EXPLoding CONDUCTORS IN THE CASE OF CURRENT PULSE LIMITATION

V.A. Letyagin, V.A. Letyagin, Yu.M. Krasnukhin and N.V. Grevtsev  
Soviet Physics Technical Physics, Vol. 19, No. 8, pp 530-532 (02/1975).

The question of the disruptive mechanism of material in an electric explosion continues to be controversial. To a considerable degree this is due to the fact that the usual investigation of the disruptive process in exploding conductors is greatly complicated by the action of many factors (strong magnetic and electric fields, the influence of the surrounding medium, various heat losses in the structure of the conductors, energy supply conditions, etc.). In the connection, the purpose of the research was to study the disruptive process of the conductors after disconnecting the current passing through them at various stages of the electric explosion and, thereby, photographing the subsequent action of the current's electromagnetic field on the conductor. 10 Refs.

Primary Keywords: Exploding Wire; Copper Wire; Photographic Diagnosis; Current Pulse; Kink Instability; Wire Explosion.

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7041  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
ELECTRICAL CHARACTERISTICS OF CONTROLLED HIGH-CURRENT TRIGGERED AIR SPARK GAPS

P. I. Shkurepet  
M. I. Kalinin Leningrad Polytechnical Institute, Leningrad, USSR  
Soviet Physics Technical Physics, Vol. 11, No. 6, pp 779-783 (04/1965).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 31, 1058-1064 (June 1965)

Triggered spark-gap devices of the trigatron type are gaining popularity in high pulse-current work and in the production of strong magnetic fields, owing to their simplicity of design and reliability of performance. There are several theories regarding the mechanism by which the discharge is initiated in such devices. The purpose of this investigation was to study the electrical characteristics of high-current trigatron spark gaps, and to elucidate the discharge initiation mechanisms in trigatrons. Two types of trigatron were investigated. In one of them, the one most frequently utilized in practice, the trigger electrode was insulated from the main electrode by a porcelain bushing. The second type of trigatron, investigated earlier, did not incorporate a readily damaged insulator bushing, so that it had a higher current handling capacity. 14 Refs.

Primary Keywords: Trigatron Spark Gap; Trigger; Probability; Operating Voltage Range vs Gap Length; Polarity Effects; Voltage Fall Measurement

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7042  
(BREAKDOWN STUDIES)  
(Electrical)  
ELECTRICAL EXPLOSION OF A CYLINDRICAL FOIL IN AIR. CURRENT DISTRIBUTION IN THE HIGH-CURRENT SHUNTING DISCHARGE

V. A. Burtsev, V. A. Dubenskii, M. P. Egorov, M. P. Kasatkina, A. B. Prokhorov and I. V. Shestakov  
Soviet Physics Technical Physics, Vol. 4, No. 6, pp 264 (04/1978).  
Trans. From: Pis'ma Zhurnal Tekhnicheskoi Fiziki 4, 654-656 (June 1975)

In this letter we report a continuation of the study of the electrical explosion of cylindrical aluminum foils in air. Earlier electrical and optical measurements and the results obtained in work on these foils are given in detail. In the present part of the work we give a more complete physical picture obtained by using magnetocapillary probes to study the spatial and temporal variations in the magnetic field generated by the current in the plasma produced in the electrical explosion of an aluminum foil. 2 Refs.

Primary Keywords: Cylindrical Foil Explosion; Aluminum Foil; Air Environment; Magnetic Field Measurement; Current Density; Spatial Resolution

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7044  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
ELECTRON-OPTICAL OBSERVATION OF INITIATION AND DEVELOPMENT OF PULSED BREAKDOWN IN A NARROW VACUUM

S. P. Bugaev, A. M. Iskhodzskii, G. A. Mosyals and D. I. Proskurovskii  
Tosk Polytechnical Institute, Leningrad, USSR  
Soviet Physics Technical Physics, Vol. 12, No. 12, pp 1625-1627 (05/1972).

Trans. From: Zhurnal Tekhnicheskoi Fiziki 37, 2206-2208 (December 1967)

There are several hypotheses explaining the initiation and development of high-vacuum breakdown. As far as pulsed vacuum breakdown in the nanosecond range is concerned, the set of hypotheses assigning primary significance to field emission from microprojections of the cathode appears most encouraging. However, one author prefers an ionization mechanism for the initiation of breakdown electron beams, and others consider the reason for breakdown to be the explosion of microscopic projections on the cathode because of heating by field emission. This paper contains results of an experiment to study the luminosity of the development of nanosecond vacuum breakdown. Cathode processes are described. 10 Refs.

Primary Keywords: Vacuum Breakdown; Nanosecond Breakdown; Optics; Output; Framing Camera; Cathode Processes

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7045  
(ELECTROMAGNETIC FIELD GENERATION)  
(Magnetic)  
ENERGY-TRANSFER EFFICIENCY OF A VACUUM BREAKDOWN SYSTEM

A. M. Timonin  
D. V. Efremov Institute, Leningrad, USSR  
Soviet Physics Technical Physics, Vol. 11, No. 2, pp 315-318 (04/1965).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 31, 1058-1064 (June 1965)

The efficiency with which energy is converted into the generation of a magnetic field in a vacuum breakdown system is found as a function of the flux compression and the field amplification. If the flux compression is limited, and extremely strong initial compression field is required for high efficiency. 6 Refs.

Primary Keywords: Flux Compression; Theory; Efficiency Calculations; High-Initial Field

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7046  
(ENERGY STORAGE, INDUCTIVE; PULSE GENERATORS)  
(Inductors; Flux Compression)  
EXTRACTION OF ENERGY FROM INDUCTIVE STORES AND EXPLOSIVE-MAGNETIC GENERATORS INTO AN INDUCTIVE LOAD USING FIELD BREAKING

V. A. Komolov, E. I. Zhuravskii, A. Kazakov and K. Chernyshev  
Moscow, USSR  
Journal of Applied Mechanics and Technical Physics, Vol. 17, No. 4, pp 664-666 (1972, 83).

In recent years the problem of obtaining high-power current pulses using inductive energy stores has drawn increasing attention. The increased interest in such devices is due to the fact that the magnetic energy density of inductive stores can markedly exceed the energy density of other energy sources. Inductive stores are most obvious in the case of pulsed energy supplies for explosive-magnetic generators operating on the principle of the rapid compression of magnetic flux. The stored energy is converted into explosive energy and the currents in the load are increased several thousandfold. However, the energy transfer from the inductive store to the load is not 100% efficient. The authors take into account the effect of the inductance of the load and determine the optimal relationship between the inductances of the load circuit and the inductance of the inductive store. 11 Refs.

Primary Keywords: Inductive Energy Storage; Flux Compression; Generators; Opening Switch; Inductive Load; Load Inductance; Transfer Efficiency

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7047  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
GENERATION AND FOCUSING OF A STRONG-CURRENT ELECTRON BEAM IN A LOW-IMPEDANCE DIODE

V. I. Liksonov, Yu. I. Sidorov and V. P. Smirnov  
JETP Letters, Vol. 19, No. 8, pp 273-275 (04/1974).  
Trans. From: ZhETF Pis'ma V Redaktsiyu 19, 516-520 (April 1974)

Results are presented on the generation of an electron beam in a low-impedance diode. There is no conventional cathode for such diodes. The construction of the cathode amplifies the influence of the preliminary charging pulse on the formation of the plasma current carrying channel between the electrodes of the accelerating gap. A beam current density  $>5E6$  A/cm<sup>2</sup> was obtained at a power flux  $>1E12$  W/cm<sup>2</sup>. The amplitude of the preliminary discharge pulse current was  $>100$  kA. 7 Refs.

Primary Keywords: E-beam Generation; Field Emission Diode; Diode Closure; Prepulse Suppression

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7048  
(BREAKDOWN STUDIES)  
(Electrical)  
HIGH-CURRENT, HOLLOW-CATHODE GLOW DISCHARGE

I. I. Aksentov, V. A. Belous and S. A. Smirnov  
Moscow, USSR  
Soviet Physics Technical Physics, Vol. 20, No. 8, pp 1094-1098 (04/1974)

Trans. From: Zhurnal Tekhnicheskoi Fiziki 45, 1717-1724 (August 1975)

A study has been made of the voltage drop in hydrogen, deuterium, and argon for pressures of 0.2 to 1 Torr at currents up to 200 A in hollow cathodes 3 and 15 mm in diameter with repetition rates of 50 Hz. The cathode is made of stainless steel or aluminum and the size of the anode cavity is varied from 0.5 to 40 mm. The measurements are made after warm-up and processing with the apparatus sealed off. The dynamic resistance of the discharge decreases as the current increases and, in certain circumstances, can take on negative values. The dependence of the voltage drop on the size of the cathode cavity is characterized by a minimum at 2 to 5 mm. 15 Refs.

Primary Keywords: Gas Breakdown; Hydrogen; Deuterium; Oxygen; Argon; Voltage Drop; 0.2 Torr Pressure; Stainless Steel; Cathode; Aluminum Cathode

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7049  
(SWITCHES, CLOSING)  
(Hydratrons, Materials)  
HYDROGEN GENERATORS FOR SEALED SWITCHES

V. K. Borcharov  
Physicochemical Institute, Academy of Sciences of the Ukrainian SSR, Kiev, USSR  
Soviet Physics Technical Physics, Vol. 21, No. 4, pp 487-489 (04/1976).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 46, 819-843 (April 1976)

Hydrogen generators made from titanium and zirconium with automatic pressure regulation and getters are described. The ranges of the ambient temperature and pressure over which these generators can operate are broader than for other generators, and when the getters are used these generators are more efficient in pumping up gases in a discharge. When these generators are used in switches the range of working pressure is double that for generators without automatic pressure regulation. 7 Refs.

Primary Keywords: Hydrogen Generator; Titanium; Zirconium; Pressure Regulation; Large Pressure Range

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7050  
(SWITCHES, OPENING)  
(Inductors; Reviews)  
INDUCTIVE ENERGY STORAGE IN PULSED ACCELERATORS

V. A. Belykh, O. A. Gusev, E. G. Kharin and M. P. Svinin  
Soviet Physics Technical Physics, Vol. 19, No. 5, pp 660-661 (11/1974).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 44, 1047-1050 (May 1974)

The design and construction of inductive energy-storage banks as well as their operating modes for direct accelerators is discussed. The design of the banks is given, and the results of experiments with such banks are reported. 4 Refs.

Primary Keywords: Inductive Energy Storage; Design Considerations; Prototype; Performance Test; Opening Switch

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7051  
(SWITCHES, CLOSING)  
(Electrical)  
INVESTIGATION OF PREIGNITION PROCESSES IN TRIGATRONS OPERATING IN AIR

P. I. Shkurepet  
M. I. Kalinin Leningrad Polytechnical Institute, Leningrad, USSR  
Soviet Physics Technical Physics, Vol. 14, No. 7, pp 943-948 (01/1970).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 39, 1256-1263 (July 1969)

Results of an experimental investigation of preignition processes in trigatrons are reported. The development of the discharge is found to proceed in two stages. Some of the characteristics of these stages are determined. 16 Refs.

Primary Keywords: Trigatron Switch; Preignition; Self-breakdown; Two-stage Discharge; Optical Diagnostics

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SP. Bugeev and G. A. Mosvets  
Tomsk Polytechnic Institute, Tomsk, USSR  
Soviet Physics-Technical Physics, Vol. 12, No. 10, pp 1363-1369  
(04/1968).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 37, 1861-1869 (October 1967)  
Experimental studies were made of the luminous phenomena accompanying breakdown along the surface of a dielectric in a vacuum and in a nonuniform field with a significant component of the electric field normal to the dielectric surface. When the cathode diameter was less than the dielectric diameter, the rate of propagation of luminosity along the cathode face was an order of magnitude less than along the anode face and amounted to  $1.7 \text{ cm/sec}$ . The nature of the breakdown currents was investigated. An explanation is given for the previously observed order on the point of electrical stability. Questions of initiation and development of the discharge are discussed. 8 Refs.  
Primary Keywords: Surface Flashover; Photographic Observation; Nonuniform Field; Prebreakdown Current; Cylindrical Cathode; Vacuum; Sharp Cathode Edges  
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7053  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
INVESTIGATION OF TRIGGERING DELAY IN A LOW-PRESSURE HOLLOW-CATHODE  
SPARK GAP  
I. I. Aksekov, V. A. Belous and S. I. Smirnov  
Soviet Physics-Technical Physics, Vol. 16, No. 7, pp 1119-1123  
1971(1972)  
Trans. from: Zhurnal Tekhnicheskoi Fiziki 41, 1423-1429 (July 1971)  
A controllable spark gap with a hollow cathode and a trigger  
electrode in the cathode cavity has been investigated. Hydrogen at a  
pressure of a few tenths of a Torr is used. The dependence of the  
trigger delay and discharge formation time on pressure, anode  
voltage, magnetic field and polarity of the trigger pulse, and  
preignition current has been studied. The triggering mechanism and  
possible applications are discussed. 5 Refs.  
Primary Keywords: Spark Gap; Hollow Cathode; Trigger In Cathode; Delay  
Measurement; Variable Pressure; Variable Voltage;  
Preignition Current  
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7055  
(PARTICLE BEAMS, ELECTRON)  
(Generation)      LINEAR INDUCTIVE ACCELERATORS WITHOUT IRON

A.I. Pevlovskii and V.S. Rasmukhin  
Soviet Atomic Energy, Vol. 37, No. 3, pp 942-947, (09/1974).  
Trans. From: *Atomnaya Energiya* 37, 228-233 (September 1974).

In order to obtain powerful single pulses of ultrarelativistic electrons, linear inductive accelerators without iron are conveniently employed. The total voltage in those accelerators, which consist of similar inductor components, acts only along the accelerating section, in analogy to accelerators with ferromagnetic elements. Linear inductive accelerators without iron are possible to reach the energy range above 10<sup>6</sup> eV and to obtain still the high currents which are characteristic of the recently developed directly operated nanosecond accelerators. The first accelerator of this type operating at the High Beam Energy 200 MeV, 20 kA, 100 ns, 10 Hz and a frequency of 5.2 MHz of the accelerating voltage. The design elements of this accelerator and the conditions of guiding the beam have been described. The present paper discusses portable and compact electrodynamic devices and design characteristics of the inductors to be used in a linear inductive accelerator without iron of 10 MeV.

Primary Keywords: E-beam Generation; LINAC; Iron-free; Accelerator; High Beam Energy

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7056  
(PARTICLE BEAMS, ELECTRON)  
(Generation) MICROPROCESSING OF ELECTRON BEAMS  
I.M. Roife, V.A. Smirnov, and V.I. Zolotarev  
D.V. Efremov Institute, Leningrad, 195190  
Soviet Physics-Technical Physics, Vol. 15, No. 1, 1978, pp. 121-123  
(12/1976).

Trans. From: Zhurn. Tekhnichesk. Fiziki 46, 2011-2016 (1976)  
English summary.

Microprocesses in which the electron beam is pulsed with a duration of 100 ns and a repetition rate of 100 Hz are described. The electron beam is located near the axis; the microprocesses are down plasma flow of the bursts. The microprocesses of the beam are described. The velocity of the electrons is an order of magnitude lower than with no microprocesses. The electron velocity is constant for 2-4 ns. The microprocesses are detected at a central aperture in the anode and in the cathode at a distance approximately 10 cm. Inspection of the traces left by the beam on photographic film with the naked eye is with a microprocess resolution that under certain conditions is the same as the resolution of the electron microscope.

Principles, Keywords: [Beam Generation; Field Emission Diodes; Microsecond Beam Duration; Magnetic Fields; Magnetic Anode Shielding]

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7258  
(ELECTROMAGNETIC FIELD COMPRESSION)  
(Magnetism)  
MOTION OF A CYLINDRICAL CONDUCTING SHELL UNDER MAGNETODYNAMIC  
COMPRESSION  
A. M. Timonin and V. A. Gerasimov  
D. V. Efremov Institute of Physics, Ural Academy of Sciences, 620090, Ekaterinburg, Russia  
Soviet Physics-Technical Physics, Vol. 38, No. 5, pp. 78A-79Z (1992)  
Trans. from Zhurnal tekh. fiziki, Vol. 62, No. 5, pp. 975-1000 (May 1992)  
The magnetodynamic interaction of a cylindrical conducting shell of arbitrary wall thickness with an external magnetic field is studied. The conditions of the shell's stability are determined. The energy losses are calculated in the process of the shell's inductive energy release. The time dependences of the currents are obtained for the case of a homogeneous magnetic field. The results of the initial calculations are compared with the results of the field with a nonuniform distribution.

Primary Keywords: Cylindrical shells; Electromagnetic fields; Magnetic fields; Magnetodynamic compression; Stability; Time dependences

Secondary Keywords: Magnetic fields; Magnetodynamic compression; Stability; Time dependences

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7059  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
NANOSECOND ELECTRON ACCELERATOR  
K.A. Zhebtov, V.I. Potekov, A.V. Polygin and V.F. Shelimov  
Instruments and Experimental Techniques, Vol. 19, No. 6, pp 1605-1607  
(12/1976).  
Trans. from: Prirody i Tekhnika Eksperimenta 6, 20-22 (December 1976)  
The present article describes a high-current pulsed electron accelerator with a maximum energy of approximately 1 MeV and a 2-5-kA beam current at a duration of approximately 2.5 nsec of the current pulses at the halfvoltage. The electrons are accelerated in a sealed vacuum diode with a field-assisted emission of electrons. The diodes were tuned in diodes designed for obtaining bremsstrahlung: a 0.1-mm-thick tantalum target is the anode. In the diodes of the other type, the target is replaced by a beryllium window which allows the transmission of the electron beam into the atmosphere. 4 Refs.  
Primary Keywords: E-beam Generation; Field Emission Diode; Two Anode Diode; Tantalum; Beryllium; 1 MeV Beam Energy; 5 kA Beam Current; 2.5 ns Beam Duration  
C.P. 1976 PLENUM PRESS, REPRINTED WITH PERMISSION

2050  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
NUMERICAL ANALYSIS OF THE FORMATION OF AN INTENSE NANOSECOND ELECTRON BEAM  
B.V. Efimov, Yu.P. Kubarikov, A.A. Drozdov and G.R. Kablatskaya  
Research Institute for Electrophysics Apparatus, Leningrad  
Polytechnical Institute, Leningrad, USSR  
Soviet Technical Physics Letters, Vol. 1, No. 10, pp 391-392 (10/1975)  
Trans. From: Fiz. Zhurnal Tekhnicheskoi Fiziki 1, 899-903 (October  
1975)  
New information in processes that determine the main features of  
the behavior of an electron beam in modern strong-current  
accelerators could not be obtained by direct measurements in  
experiments, but also by comparing the experimental data with the  
results of detailed numerical calculations that employ various  
models. In this note we present the result of a numerical analysis of  
the formation of a pulsed relativistic electron beam (REP) in  
accelerator systems like REP-5, REP-5S, and others, with maximum  
current amplitudes below the critical value. 9 Refs.  
Primary Keywords: E-beam Generation; Numerical Simulation; Shaping  
of Beams; Diode Gap; High-Gap; Diode Considerations; Circuits  
Considerations; Diode Impedance; Fowler-Nordheim  
Equation  
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7061  
(PULSE GENERATORS; ELECTROMAGNETIC FIELD GENERATION)  
(Flux Compression; Magnetic)  
NUMERICAL CALCULATION OF THE MAGNETIC CUMULATION PROCESS  
A.V. Kosharskiy and V.A. Odintsov  
Moscow, USSR  
Journal of Applied Mechanics And Technical Physics, Vol. 11, No. 3, pp  
634-638 (1976, 1977)  
Trans. from: Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki 11,  
51-55 (May-June 1976)  
A numerical calculation is made of the process in the MK-1  
magnetocumulative generator under the assumption that the magnetic  
flux is constant and the tube contraction process is one-dimensional.  
The instantaneous detonation scheme is adopted. The effect of initial  
magnetic field intensity and relative size of the cavity on the  
magnitude of the maximal magnetic field intensity obtained inside the  
tube is studied. 4 Para.  
Primary Keywords: Flux Compression; Theory; Numerical Calculation; 1-  
Calculation; Maximum Field Intensity; Initial Field  
Density; Size

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1.62  
FLUX STORAGE, CHEMICAL; PULSE GENERATORS)  
(Flux Compression on Generators; Flux Compression)  
1. S. N. KRYUKOV, D. P. POPOV, P. N. POPOV, FROM A MAGNETOCUMULATIVE GENERATOR  
A. S. Kulevskii, G. D. Kulezhov, R. Z. Lyudskov, L. N. Robkin and A. S.  
Sudakov  
Soviet Atomic Energy, Vol. 41, No. 2, pp 757-760 (08/1976).  
English transl. in Atomic Energy, Vol. 142-144 (August 1976)  
The main supply for charged-particle accelerators, operating in the single-pulse regime, usually is effected from condensers of industrial production of electrical energy. More frequently, the power source is a capacitor bank, which often reaches tens and hundreds of kilojoules and have a mass of many tons. These power supply sources can be used mainly under steady-state conditions. At the same time, there are problems which require the use of transportable accelerator facilities. Because of this, a power supply system has been considered for high-powered pulsed air-cored transformers with a capacitive storage inductance (MCG), with a specific power capacity which is greater by a factor of thousands and tens of thousands than condenser storage devices. 4 Refs.  
Primary Keywords: Flux Compression Generators; Explosive Driven; Low Inductance Load  
Secondary Keywords: Betatron  
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7083  
BREAKDOWN STUDIES: SWITCHES; CLOSING)  
(Plasma Radiation; Gas Gaps; Radiation)  
REDUCTION OF GAS BREAKDOWN VOLTAGE WITH PULSED IONIZING RADIATION  
A. A. Lentsov and V. A. Fokhtistov  
Moscow, USSR  
Journal of Applied Mechanics and Technical Physics, Vol. 14, No. 6, pp. 952-955, 1973.  
English transl., J. Appl. Mech. Engng., 1973, No. 12, p. 1913.  
Russian transl. in Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki 6, No. 6, pp. 57-60, November-December 1973).

An algorithm is described for computer calculation of the dynamic breakdown voltage of a gas gap affected by a spatially uniform pulse of ionizing radiation. The algorithm is based on numerical integration of a system of nonlinear equations with integral boundary conditions. The program is used to calculate the breakdown voltage of a gas gap affected by a ball-shaped ionizing pulse. It is shown that a relative reduction in breakdown voltage can amount to tens of percent for a radiation exposure dose rate  $P_{\text{sub}}$  of approximately  $10^4$  rads/sec.

\*\*\*  
Lentsov, A. A. Gas Breakdown Under Ionizing Radiation: Pulsed Breakdown Voltage under With Radiation Exposure; Space Charge;  
J. Appl. Mech. Engng., 1973, No. 12, p. 1913. PERMITTED BY PERMISSION

7054  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
REGULATING THE MAGNETIZATION OF FERRITE IN EXPERIMENTS ON THE  
SELF-ACCELERATION OF AN ELECTRON BEAM  
A.A. Rakityanskii  
Instruments And Experimental Techniques, Vol. 22, No. 2, pp 327-329  
(06/1977)  
Trans. From: Pribury i Tekhnika Eksperimenta 2, 37-40 (March-April  
1977)  
A means of regulating the magnetization of ferrite is described  
which allows the choice of the optimum conditions in the process of  
self-acceleration of beams in ferrite structures. The magnetizing is  
accomplished with two coaxial solenoids which are simultaneously used  
to focus the beam. The results of an experimental investigation of  
the described means are presented.  
Primary Keywords: E-beam Generation; Self-acceleration; Ferrite Ring;  
Magnetization; Coaxial Solenoid  
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7066  
(SWITCHES, CLOSING)  
(Gas Gaps, System)  
STUDY OF PARALLEL OPERATION OF CONTROLLED SPARK GAPS  
S.L. Zelenits, G.S. Kichayeva and P.I. Shkurcepap  
M.I. Kulinin Leningrad Polytechnical Institute, Leningrad, USSR  
Soviet Physics-Technical Physics, Vol. 7, No. 11, pp 1023-1028  
(06/1977)  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 52, 1386-1391 (November 1962)  
The parallel operation of several controlled spark gaps at a  
working voltage of 50-150 kV was investigated in a circuit similar to  
that of a generator of large pulsed currents with delay cables. The  
practicability of parallel operation of the gaps is demonstrated.  
Recommendations for the design of such generators are given. 6 Refs.  
Primary Keywords: Spark Gap; Triatron; Parallel Operation; 150 kV  
Operating Voltage; Design Considerations  
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7067  
(PULSE GENERATORS; ENERGY STORAGE, CHEMICAL; SWITCHES, OPENING)  
(Flux Compression; Flux Compression Generators; Explosive Fuses)  
TAKE-OFF OF ENERGY FROM EXPLOSIVE-MAGNETIC GENERATORS TO AN INDUCTIVE  
LOAD USING THE BREAKING OF A CIRCUIT  
V.A. Demidov, E.I. Zharinov, S.A. Kazakov and V.K. Chernyshev  
Moscow, USSR  
Journal Of Applied Mechanics And Technical Physics, Vol. 20, No. 1, pp  
32-36 (02/1979)  
Trans. From: Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki 1,  
43-48 (January-February 1979)  
The use of explosive-magnetic generators (EMG) for plasma  
experiments and for other physical investigations, along with  
questions of increasing the electromagnetic energy, poses the problem  
of the formation, in the external load, of current pulses with steep  
leading fronts in the microsecond range. One method for the rapid  
take-off of energy to the load is the breaking of the finite circuit  
of the explosive-magnetic generator. This is done using commutators  
based on the electrical explosion of thin conductors or on the basis  
of the mechanical breakdown of conductors by a charge of explosive.  
The aim of the present work was a determination of the form of the  
pulses of the current and the energy in an inductive load as a  
function of the resistance of the discontinuity introduced into the  
circuit of an explosive-magnetic generator, taking into account of the  
parasitic inductance of the commutating device. 14 Refs.  
Primary Keywords: Explosive Flux Compression Generators; Inductive  
Load; Analysis; Theory; Comparison With Experiment  
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7068  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
DETECTION OF ELECTRODE VAPOR BETWEEN PLANE PARALLEL COPPER ELECTRODES  
PRIOR TO CURRENT AMPLIFICATION AND BREAKDOWN IN VACUUM  
D.K. Davies and M.A. Biondi  
Westinghouse Research and Development Center, Pittsburgh, PA  
Journal Of Applied Physics, Vol. 41, No. 1, pp 424-428 (01/1970)  
Simultaneous, time-resolved measurements of cathode glow and  
resonance line absorption have been made for the first time in a  
plane-parallel copper electrode vacuum gap. The glow is observed at  
0.8 microsecond, respectively, after the breakdown voltage is reached  
and has been carried out for an electrode separation of 0.1 mm. Residual  
pressures in the low 10<sup>-6</sup> Torr range. The experimental data show that  
neutral copper vapor is being produced in the prebreakdown phase. Before  
the current increases sufficiently to cause the glow, the vapor density  
that the vapor is generated in the time between the glow and the  
microseconds prior to breakdown, and is highly localized to the  
region of the subsequent spark channel. Further, the vapor density  
decreases from cathode to anode along the path of the subsequent  
spark channel. The results are consistent with a model for vacuum  
breakdown proposed recently in which the transient production of  
vapor immediately prior to breakdown occurs by the evaporation of an  
anode macroparticle during its transit to the cathode; amplification  
of the prebreakdown current in this vapor then leads to breakdown.  
From the data obtained in the present experiment, it appears that  
breakdown occurs primarily while the macroparticle is located between  
mid-gap and the cathode. 9 Refs.  
Primary Keywords: Vacuum Breakdown; Prebreakdown Current; Current  
Growth; Copper Vapor; 10<sup>-6</sup> Torr Pressure; Resonance  
Line Absorption  
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7070  
(BREAKDOWN STUDIES)  
(Gas, E-beam)  
VOLUME DISCHARGE EXCITED IN A GAS BY AN ELECTRON BEAM IN THE CASE OF  
A PHENOMENOLOGICAL SYSTEM OF EVALUATION  
Z.B. Evdokimov, G.A. Mervinskii and V.A. Ponomarev  
Academy of Sciences of the USSR, Leningrad, USSR  
Soviet Journal Of Plasma Physics, Vol. 3, No. 2, pp 203-206 (04/1977)  
Trans. From: Fiz. Plazmy 3, 157-164 (March-April 1977)  
A phenomenological system of evaluation is used to analyze the  
processes occurring with the column of a gas discharge excited by an  
electron beam in the case in which there is an inhomogeneous  
distribution of the rate of ionization of electron ion pairs across  
the discharge gap. The energy balance of the process and the steady  
state are studied. The effect of the inhomogeneity of the electric  
field and the specific power of the discharge column are found. The  
voltage-current characteristics are calculated. It is shown that the  
solution for the electric field in the column has an extremum at an  
early time (after a time short compared with the time required to  
reach steady-state conditions). At a beam current density of the  
order of a few hundred A/cm<sup>2</sup>, the electron temperature is thermalized  
electrons can distort the field distribution at early times. 11 Refs.  
Primary Keywords: Gas Breakdown; E-beam Excited Glow; Volume  
Discharge; Phenomenological System of Evaluation; Theory  
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7071  
(SWITCHES, OPENING)  
(Explosive Fuses)  
A MEGAAMPERE SWITCH WITH AN EXPLODING FOIL FOR THE INVESTIGATION OF  
MAGNETIC CUMULATION  
V.G. Kuchinskii, V.T. Mikhkel'son and G.A. Shnererson  
Leningrad Polytechnical Institute, Leningrad, USSR  
Instruments And Experimental Techniques, Vol. 16, No. 3, pp 783-786  
(06/1973)  
Trans. From: Pribury i Tekhnika Eksperimenta 3, 108-112 (May-June 1977)  
A device with an exploding foil allows the rise time of the  
current in the discharge current of a capacitor bank into a one-turn  
solenoid to be reduced by a factor of 10 to 15, and a current having  
an amplitude of 1 MA to be obtained. A switch device is described  
which is used in a circuit for investigating magnetic cumulation. A  
procedure for choosing the parameters of the foil is expounded, and  
the possibility of using simple phenomenological models to describe  
the variation of the foil resistance during the cumulation process  
is considered. 8 Refs.  
Primary Keywords: Exploding Foil; Pulse Front Sharpening; 1 MA  
Current; Foil Parameterization; Design  
Considerations; Phenomenological Explosion Model  
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7073  
(BREAKDOWN STUDIES)  
(Liquid, Electrical)  
CHARACTERISTICS OF AN UNDERWATER SPARK  
V.V. Shenko and E.V. Krivitskii  
Planning And Design Bureau Of Electrohydraulics, Academy of Sciences of  
the Ukrainian SSR, Nikolayev, USSR  
Soviet Physics-Technical Physics, Vol. 22, No. 1, pp 52-57 (01/1977)  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 47, 93-101 (January 1977)  
The energy balance in the channel of an underwater spark is  
analyzed for the main stage of the discharge, the first current  
pulse. It is shown that for a homogeneous discharge the specific  
internal energy is proportional to the conductivity of the spark  
during the time interval. The radiation energy is calculated roughly  
for a broad range of discharges under the assumption that the channel  
emits as an absolute blackbody. The radiation energy constitutes a  
small fraction of the overall energy balance and can be neglected.  
The diameter of the spark channel, visible in transmitted light is  
related to the channel resistance. Approximate expressions are found  
for the motion of the spark channel and for its initial  
parameters: the radius and the electrical resistance. 12 Refs.  
Primary Keywords: Water Breakdown; Energy Balance; Homogeneous  
Discharge; Blackbody Radiation; Channel Resistance  
Calculation; Theory  
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7074  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES)  
(Liquid, Electrical; Surface Flashover)  
CREEPAGE DISCHARGE ALONG THE SURFACE OF SOLID DIELECTRICS IN WATER  
P.M. Dnestrov, A.S. Emel'yanov and T.A. Ivanova  
Soviet Physics Journal, Vol. 11, No. 2, pp 71-74 (02/1968)  
Trans. From: Izvestiya VUZ, Fizika 11, 111-117 (1968)  
Experimental data is given for the discharge voltage for creepage  
discharge in tap water as a function of the thickness, flange length,  
creepage path over dielectric surface, permittivity of the solid  
dielectric, field configuration, polarity of the applied voltage  
and a number of other parameters. The experimental data  
discussed are the delay time with dielectric flange sparkover by  
creepage discharge, the average discharge propagation rate for both  
polarities, and the creepage discharge current and leakage  
currents. 5 Refs.  
Primary Keywords: Creepage Discharge; Tap Water; Dielectric Surface;  
Flange Length; Solid Insulator Permittivity; Field  
Configuration; Pulse Length  
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7075  
(BREAKDOWN STUDIES)  
(Liquid, Electrical)  
EFFECT OF A TRANSVERSE MAGNETIC FIELD ON THE BREAKDOWN IN A HIGH-VACUUM  
DISCHARGE GAP  
V.A. Petrov and N.V. Cherkashin  
Soviet Physics-Technical Physics, Vol. 22, No. 5, pp 565-569 (05/1977)  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 47, 946-953 (May 1977)  
The effect of a transverse magnetic field on the breakdown field  
of a vacuum discharge gap is studied experimentally for residual gas  
pressure p ≤ 1E-4 - 1E-7 Torr in the working volume. The length of the  
discharge gap, d, and the shape of the working surface of the  
electrodes are varied in the experiments. The magnetic field is  
varied over the range H = 0-8000 Oe. The experimental data on the  
breakdown voltage of a high-vacuum discharge gap, U/sub br/ are  
described by empirical functions, U/sub br/ = f(p, d, H). 6 Refs.  
Primary Keywords: Vacuum Breakdown; Transverse Magnetic Field;  
Variable Gap Spacing; Variable Electrode Geometry;  
6000 Oe Field; Empirical Formula  
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7078  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES; INSULATION, MATERIAL;  
INSULATION, MATERIAL)  
(Electrodes; Gas; Electrical; Gas; Liquid)  
EFFECT OF CATHODE SURFACE STATE ON THE DIELECTRIC STRENGTH OF GASES AND LIQUIDS

Yu. L. Stankevich and V. G. Kalinin  
Soviet Physics-Technical Physics, Vol. 14, No. 7, pp 949-954 (01/1970).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 39, 1264-1271 (July 1969).  
Effects of the cathode surface state on the dielectric strength of gases at high pressures and of capacitor oil in thin ( $\leq 0.2$  mm) gaps have been studied. The mechanisms for the possible effects of various types of surface irregularities and contaminants on the pressure dependence of the static and pulsed breakdown voltages for gases have been examined. The experimental results show that the polycrystalline structure of the cathode is one reason for the scatter and nonreproducibility of breakdown voltages in gases at high pressures, especially with small interelectrode gaps. The use of single-crystal cathodes permits higher prebreakdown voltages in both gases and liquids. Covering the cathode surface with a thin liquid-dielectric film significantly increases the pulsed dielectric strength in a gas-filled gap. The results agree with the hypothesis that the main source of primary electrons during breakdown by short voltage pulses is field emission from the cathode surface. 7 Refs.

Primary Keywords: Gas Dielectric Strength; Liquid Dielectric Strength; Cathode Surface Effects; Several Gases; Transformer Oil; Single-crystal Cathode; Polycrystalline Cathode; Dielectric Liquid Cathode Film.  
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7079  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
EFFECT OF ELECTROSTATIC FORCES IN VACUUM BREAKDOWN

I. L. Gufeld and V. V. Postnov  
All-Union Institute, Moscow, USSR  
Soviet Physics-Technical Physics, Vol. 23, No. 8, pp 994 (05/1978).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 48, 1750-1751 (August 1978).  
Electrostatic forces play two roles in the prebreakdown state: They activate diffusive mass transport and damage the surface layers, thus increasing the field at surface irregularities and reducing the average breakdown field. If these processes are to occur the field magnification at the microscopic protruberances must be a factor of a hundred or more. In certain cases, e.g., removal of aggregates which are weakly bound to the surface (polishing products) or the removal of elements of deposited film, the field magnification need not be high. 5 Refs.

Primary Keywords: Vacuum Breakdown; Prebreakdown Current; Field Magnification; Microprojections.  
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7080  
(BREAKDOWN STUDIES)  
(Liquid, Electrical)  
ELECTRICAL BREAKDOWN IN WATER BY 0.5-1.7-MV PULSES 0.5-5 MICROSECOND LONG

V. D. Tarasov, V. A. Balakin and O. P. Pecherskii  
Soviet Physics-Technical Physics, Vol. 16, No. 8, pp 1379-1380 (02/1972).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 41, 1749-1750 (August 1972).  
The electrical strength of outgassed and purified water is investigated in a uniform field produced by a sinusoidal voltage with amplitude 0.5-1.7 MV and a pulse length of 0.5-5 microseconds. The breakdown field is about 300 kV/cm for 5-microsecond pulses and increases to 480 kV/cm for 0.5-microsecond pulses. 5 Refs.

Primary Keywords: Water Breakdown; 0.5-5 Microsecond Pulse Length; 300-480 KV/cm Breakdown Field; Coaxial Lines; Electrical Strength Of Water; 0.5-1.7 MV Voltage.  
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7081  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
ELECTRICAL CHARACTERISTICS OF UNDERWATER EXPLODING

V. K. Sholom, E. V. Krivitskii and V. V. Postnov  
Soviet Physics-Technical Physics, Vol. 19, No. 10, pp 1722-1723 (04/1975).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 45, 2164-2165 (October 1975).  
Using the condition of approximate similarity for the electrical characteristics of an underwater explosion of wires, empirical equations are obtained which make it possible to determine the inductive peak overvoltage, the minimum and maximum values for which are struck, and the maximum current in the arc stage of the discharge as functions of the parameters of the discharge circuit. The parameters of the maximum discharge are obtained for discharges corresponding to the boundary of the current break conditions are defined for producing the maximum rate of energy deposition in the discharge gap. 11 Refs.

Primary Keywords: Exploding Wire; Underwater Explosion; Empirical Equation; Peak Voltage Calculation; Minimum Arc Current Calculation.  
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7082  
(INSULATION, MATERIAL)  
(Solid)  
ELECTRICAL CONDUCTIVITY OF DIELECTRICS IN STRONG SHOCK WAVES

A. A. Briksh, S. Tarasov and V. A. Balakin  
Soviet Physics-Technical Physics, Vol. 11, No. 1, pp 15-17 (01/1965).  
Trans. From: Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki 38, 22-25 (January 1960).  
The electrical conductivity of air, water, and certain solid dielectrics subjected to strong shock waves has been measured by electrical contact method. The measured values of the specific conductivity in the shock front are as follows: air, 0.5 ohm-cm; water, 0.2 ohm-cm. At shock front pressure approx. 10 kbar, it is found that the electrical conductivity of dielectrics or paraffin reaches 10 to 200 ohm-cm, a value which approximates the conductivity of a metal. 5 Refs.

Primary Keyword: Shock Wave.  
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7084  
(BREAKDOWN STUDIES)  
(Electrodes)  
EROSION RATE AND PROPERTIES OF A CATHODE SPOT OF THE FIRST KIND WITH SILVER ALLOYS

A. I. Struchkov and N. L. Pravoverov  
All-Union Institute, Moscow, USSR  
Soviet Physics-Technical Physics, Vol. 23, No. 11, pp 1322-1324 (11/1978).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 48, 2309-2312 (November 1978).  
The erosion rate of silver alloys in the solid-solution region is governed by the electrical resistivity at the melting point. This feature explains why the erosion rate is essentially independent of the heat treatment of the alloy. Estimates of the erosion rate for high-resistivity alloys on the basis of the explosive model agree with the experimental results. The theoretical values of the erosion rate for low-resistivity alloys are twice the experimental values; the discrepancy arises because the explosive model neglects the heat removal from the current-concentration region. 10 Refs.

Primary Keywords: Cathode Spot Properties; Erosion Rate Estimates; Explosive Model; High Thermal Conductivity; High Electrical Conductivity; Silver Alloys.  
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7085  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
EXPLODING WIRE MECHANISM

E. V. Krivitskii and V. P. Litvinenko  
Planning and Design Of Bureau Of Electrodynamics, Nikolaev, USSR  
Soviet Physics-Technical Physics, Vol. 21, No. 10, pp 1218-1221 (10/1976).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 46, 2021-2027 (October 1976).  
The models which have been proposed for exploding wires are analyzed in terms of the destruction of wires caused by high current pulses for various external conditions. The initial point of the explosion can be determined from superimposed simultaneous oscillations across the voltage across the test samples. The time constant (the scale time of the explosion) is governed by the properties of the wire, the rate at which energy is supplied, and the hydrodynamic characteristics of the surrounding medium. Confirmation is found for the suggestion that the loss of metallic conductivity is due to processes which occur simultaneously throughout the wire volume. 21 Refs.

Primary Keywords: Exploding Wire; Initial Point Of Explosion; Time Constant; Wire Geometry; Environment Considerations; Theory.  
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7086  
(PARTICLE BEAMS, ELECTRON; BREAKDOWN STUDIES)  
(Generation; Exploding Wires)  
EXPLOSIVE ELECTRON EMISSION AND EXPLODING WIRES

M. M. Martynuk  
Patrice Lumumba University of International Friendship, Moscow, USSR  
Soviet Physics-Technical Physics, Vol. 23, No. 7, pp 837-844 (07/1978).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 48, 1482-1493 (July 1978).  
The role played by explosive boiling (phase explosion) of a liquid metal in exploding wires and exploding sharp metal points is studied. If the pulse length  $t_{\text{sub}}/t_{\text{sub}} \approx 10^{-7}$  to  $10^{-5}$  sec, the explosion is governed by the stationary homogeneous nucleation of vapor nuclei (stationary phase explosion). If the pulse length  $t_{\text{sub}}/t_{\text{sub}} \approx 10^{-8}$  to  $10^{-6}$  sec the process is not stationary. Data on exploding wires are used to calculate the temperature and the current density in the thermionic emission from several metals at the beginning of the stationary phase explosion. The effect of the electric field on the thermionic emission is taken into account. At the initial stage in the electrical explosion of a sharp metal tip the field emission dominates, giving way to explosive emission of electrons. The current rise in the initial stage of explosive emission is due to the rapid increase in the emitting surface area in the explosive formation of a metal dispersed vapor-liquid mixture. The decomposition of this thermodynamically unstable phase may play a role in the nonstationary electrical explosion of sharp metal points and in exploding wires. The results are used to estimate the temperature, current density, and intensity of explosive cathode spot in a vacuum arc. 33 Refs.

Primary Keywords: Explosive Electron Emission; Exploding Wires; Metal Vaporization; Vapor Nucleation; Long Pulse Length; Stationary Process; Short Pulse Length; Non-stationary Process; Theory.  
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7088  
(WIRE CONDITIONING; WIRE CONDITIONING)  
(Fusion Forming Lines; Stable Reactors)  
FORMATION AND PROPAGATION OF ELECTROMAGNETIC SHOCK WAVES IN TRANSISTORS CONTAINING UNSATURATED FERRITE

L. A. Ostrovskii  
Soviet Physics-Technical Physics, Vol. 8, No. 9, pp 805-813 (03/1964).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 33, 1080-1092 (September 1963).  
A discussion is given of the nonlinear phenomena observed in transistors on lines containing a ferrite, in which the remagnetization takes place incoherently. A study is made of the dissipative mechanism of shock wave formation, as well as the development of strong discontinuities. 10 Refs.

Primary Keywords: Unsaturated Ferrite; Nonlinear Phenomena; Transmission Lines; Remagnetization; Electromagnetic Shock Wave Formation; Magnetic Field Rate Of Change.  
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7089  
(PULSE GENERATORS; SWITCHES; CLOSING; SWITCHES; OPENING)  
(Capacitor Banks; Gas Gaps; Electrical; Gas Gaps; Magnetic Field)  
A GENERATOR THAT PRODUCES POWERFUL PULSES USING GAS-DISCHARGE  
COMMUTATORS OF THE TRIOTRON AND TRIPLASMATRON TYPE  
A.I. Vishnevskii, A.I. Kuz'michev, V.I. Krizhenovskii, A.I. Soldatenko  
and A.I. Shendakov  
Kiev Polytechnical Institute, USSR  
Instruments And Experimental Techniques, Vol. 16, No. 5, pp 1417-1419  
(1973)  
Trans. From: Priroda i Tekhnika Eksperimenta 5, 104-106  
(September-October 1973)  
The possibility of creating a pulse generator (modulator) with  
partial discharge of the storage device using gas-discharge devices  
having a cold cathode and two-way control (triotrons and  
triplasmatrons) is demonstrated. The ignition of the discharge in the  
devices takes place when a positive pulse is applied to the control  
electrode. Extinction occurs when the magnetic field is removed or  
reduced below of critical value. A sub-critical generator operates in a  
stable manner at a voltage of up to 15 kV and allows current pulses  
of close to 300 A to be obtained with smooth control of their length  
in the 10 to 150 microsecond range. 4 Refs.  
Primary Keywords: Pulse Generator; Triotrons; Gas Switch; Magnetic  
Field; Control Geometry; Partial Store Discharge  
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7090  
(BREAKDOWN STUDIES; SWITCHES; CLOSING)  
(Vacuum; Electron; Vacuum Gaps; E-beam)  
INITIATION OF ELECTRICAL BREAKDOWN IN VACUUM BY AN ELECTRON BEAM  
M.V. Balon, E.K. Ostrovskii, V.F. Gaidukov, I.V. Strelkov and L.N.  
Kaleshnikov  
Soviet Physics-Technical Physics, Vol. 16, No. 3, pp 436-438 (09/1971)  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 41, 563-566 (March 1971)  
A system has been investigated for initiating a discharge in high  
vacuum using an electron beam. The dependence of discharge delay time  
on electron-beam parameters is presented. It is shown that the  
breakdown time is associated with a specific temperature in the  
region of the anode bombarded by the electrons. 7 Refs.  
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7091  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
MHD CALCULATION FOR EXPLODING WIRES  
Yu.D. Bakulin, V.F. Kuropatenko and A.V. Luchinskii  
Soviet Physics-Technical Physics, Vol. 21, No. 9, pp 1144-1147  
(09/1976)  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 46, 1963-1969 (September  
1976)  
A method of analyzing electric circuits with exploding wires is  
presented. This MHD analysis describes the entire explosion of copper  
wires with an accuracy suitable for practical purposes. The  
conductivity of copper is found as a function of the density and  
specific thermal energy by a method based on theory and experiment.  
The calculations use an equation of state for the metal which takes  
the evaporation of the metal into account. Calculated results are  
given, and compared with experimental data. 11 Refs.  
Primary Keywords: Exploding Wires; Copper Wires; MHD Analysis; Copper  
Conductivity; Equation of State; Theory  
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7092  
(BREAKDOWN STUDIES)  
(Liquid; Electrical)  
PREDISCHARGE PHENOMENA IN LIQUIDS  
L.E. Belyaev  
Soviet Physics JETP, Vol. 3, No. 3, pp 355-361 (10/1956)  
Trans. From: Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki 30,  
464-470 (March 1956)  
The results of an investigation of predischarge phenomena in  
transformer oil, castor oil, xylene and distilled water are  
presented. At voltages sufficient for breakdown, it is shown that  
ionization collision occurs during the statistical delay period,  
resulting, in a time of approximately 10<sup>-6</sup> sec, in the production of  
electron avalanches and small streamers. It is shown that these do not  
lead to cumulative breakdown, but are a preparatory stage. It has  
been established that breakdown occurs when the size of the streamer  
is greater than 5-8 x 10<sup>-5</sup> cm. It is also shown that in a still  
water with highly inhomogeneous fields the breakdown mechanism  
depends on the polarity of the point. The latter is distinctive  
during the statistical delay period. The statistical delay period of  
very small radius is formed in about 10<sup>-6</sup> sec. 15 Refs.  
Primary Keywords: Liquid Breakdown; Streamer Phenomena;  
Collisions; Avalanches; Statistical Delay  
Mechanism; Avalanches; Statistical Delay  
Dist. Castor Oil; Xylene  
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7094  
(BREAKDOWN STUDIES; SWITCHES; CLOSING)  
(Vacuum; Electrical; Vacuum Gaps; Electrical)  
SPECTROSCOPIC STUDY OF A CONTROLLED DISCHARGE IN A HIGH-VOLTAGE VACUUM  
SWITCH  
G.S. Kiricheva and M.L. Chepkalenko  
M.I. Kalinin Leningrad Polytechnical Institute, Leningrad, USSR  
Soviet Physics-Technical Physics, Vol. 16, No. 10, pp 1704-1707  
(04/1972)  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 41, 2151-2155 (October 1971)  
Spectral methods have been used to study effects due to the  
materials used in the elements of a controlled high-voltage switch  
(cathode, anode, arcing systems, and insulating wall) at an  
initial pressure of 10<sup>-5</sup> to 10<sup>-6</sup> Torr in the working chamber. A  
periodic (0.1-1.5 microsecond) current at 1-7 kA is used. The  
emission spectra are studied in the gas as a whole and in individual  
regions during the spark and discharge spectra are studied in the  
primary gap with various cathode materials. The materials of the  
primary and control electrodes, the insulation of the triggering  
system, and the insulating walls of the vacuum chamber (near the  
electrodes) affect the discharge. The discharge in a controlled way  
is due to propagation of a plasma jet from the ignition region. 10  
Refs.  
Primary Keywords: Vacuum Breakdown; Triggered Vacuum Gap;  
Spectral Methods; Spark Discharge; High Voltage; High Current  
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7095  
(PARTICLE BEAMS; ELECTRON)  
(Generation)  
THE LIU-10 HIGH-POWER ELECTRON ACCELERATOR  
A.I. Pavlovskii, V.S. Bosenykin, V.A. Savchenko, A.P. Klement'ev, K.A.  
Morozov, V.S. Nikol'skii, A.I. Gerasimov, V.A. Tananakin, V.F.  
Bashinov, D.I. Zankov, V.D. Selenir and A.S. Fedotkin  
Soviet Physics Doklady, Vol. 25, No. 2, pp 120-122 (02/1980)  
Trans. From: Doklady Akademii Nauk SSSR 250, 1118-1122 (February 1980)  
During the past few years a new direction has been explored in the  
creation of high-power generators of charged-particle beams with  
energies of several tens of MeV-linear induction accelerators (LIA)  
with inductors employing radial lines, which combine the possibility  
of variation of the acceleration energy, by varying the scale of the  
acceleration system, with the high current capacity associated with  
direct discharge of low-impedance lines with distributed parameters.  
This paper gives a short description of the construction and  
performance of the LIU-10 accelerator. 5 Refs.  
Primary Keywords: Linear Induction Accelerators; Radial Lines;  
Acceleration Energy Variation; High Current  
Capacity; LIU-10 Accelerator; Electron Flux  
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7096  
(POWER CONDITIONING)  
(Pulse Forming Lines)  
THE STRUCTURE OF THE FRONT OF ELECTROMAGNETIC SHOCK WAVES IN  
TRANSMISSION LINES WITH NONLINEAR PARAMETERS  
A.M. Balyantsev, A.V. Gerasimov and G.I. Fraiman  
Radio-Physical Scientific Research Institute, Gorki State University,  
USSR  
Soviet Physics-Technical Physics, Vol. 10, No. 4, pp 531-539 (10/1965)  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 35, 677-683 (April 1965)  
The profile of an electromagnetic wave which propagates in a  
nonlinear, nondispersive medium is distorted during the propagation  
process in such a manner that breaks can occur in the continuity of  
the field vectors, and electromagnetic shock waves are generated. In  
exactly the same way as in the corresponding problem of gasdynamics  
or magnetohydrodynamics, the presence of scatter in the  
high-frequency region eliminates the discontinuities in the solutions  
which describe the electromagnetic waves in nonlinear media; in  
particular, it also leads to the establishment of a finite width of  
the shock-wave front. In the present article one-dimensional  
electromagnetic waves are considered in transmission lines with  
nonlinear parameters. Particular attention shall be paid to the  
relation between the structure of the shock-wave front and the  
scattering properties of the transmission line. 12 Refs.  
Primary Keywords: Pulse Forming Line; Shock Wave; Dispersion; Finite  
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7098  
(SWITCHES; CLOSING)  
(Gas; Cond. Electrical)  
TRANSIENT BEHAVIOR OF A HIGH-VOLTAGE LOW-PRESSURE TRIGGERED SPARK GAP  
G.S. Kiricheva  
M.I. Kalinin Leningrad Polytechnical Institute, Leningrad, USSR  
Soviet Physics-Technical Physics, Vol. 16, No. 9, pp 1552-1555  
(09/1972)  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 41, 1963-1968 (September  
1971)  
Delay times and jitter of a triggered spark gap have been  
investigated at 5-50 kV and initial pressures in the range  
approximately 4E-5 - 6E-2 mm Hg as a function of gap size (3-34 mm),  
voltage polarity, triggering arrangement, and triggering current.  
At pressures approximately 4E-3 mm Hg and greater the triggering  
mechanism is associated with ionizing collisions between the residual  
gas and electrons from the trigger spark. At lower pressures (1E-5 -  
1E-5 mm Hg) the role of the plasma jet from the ignition region  
dominates. 13 Refs.  
Primary Keywords: Triggered Spark Gap; Triggering; Delay Measurement;  
Jitter Measurement; 4E-5 - 6E-2 Pressure Range; 50  
kV Operating Voltage; Triggering Mechanism  
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7099  
(PARTICLE BEAMS; ELECTRON)  
(Acceleration)  
A PHASED ELECTRON BEAM ACCELERATOR "ARAGUEN"  
A.P. Avramov, V.T. Boverintsev, E.L. Astrelin, V.A. Kapitonov and V.M.  
Lashov  
Institute of Nuclear Physics, Siberian Div. of the USSR Academy of  
Sciences, Novosibirsk, USSR  
IEEE 1976 Pulsed Power Conference Proceedings, Paper III-11 (12/1976)  
The accelerator "Araguen" is designed for producing the pulsed  
electron beam with a current of 400 kA, an electron energy of 1.2 MeV  
for 60 ns. The expected total beam energy is about 10 to 15 kJ. The  
accelerator will be used for plasma heating by relativistic electron  
beam in the model experiments on the dense plasma confinement in the  
multiple mirror device "GOL-11". 20 Refs.  
Primary Keywords: "Araguen" Accelerator; High Current; High Energy;  
Water Dielectric; Numerical Calculation; Field  
Calculation  
Secondary Keywords: Plasma Heating  
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7130  
(PULSE GENERATORS; SWITCHES; CLOSING)  
(Trigger; Tacitrons)  
A PULSE GENERATOR BASED ON TACITRONS  
V.D. Dvornikov, S.T. Latashkin, L.I. Tudin and V.M. Komarov  
Atomic Energy Institute, Moscow, USSR  
Instruments And Experimental Techniques, Vol. 18, No. 2, pp 433-438  
(04/1975)  
Trans. From: Priroda i Tekhnika Eksperimenta 2, 107-110 (March-April  
1975)  
A circuit is presented for shaping voltage pulses across a distant  
capacitive load of approximately 10 pF using industrial TGU-5/12  
tacitrons as the commutating elements. The output pulses have an  
amplitude of 20 kV at a rectifier voltage of 5 kV, and a length of  
approximately 70 nsec for a leading-edge duration not exceeding 35  
nsec. The instability of the delay of the output pulses relative to  
the pulses at the input of the tacitrons is approximately 1 nsec. The  
repetition frequency of the pulses is 120 kHz. 8 Refs.  
Primary Keywords: Pulse Generator; Tacitron Switch; 20 kV Output  
Voltage; 20 ns Pulse Length; 1 ns Jitter  
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7101

(POWER CONDITIONING)

(Pulse Forming Networks)

A SHAPER THAT PRODUCES SHORT PULSES ACROSS A CAPACITIVE LOAD

L.Z. Gogolitsyn

Leningrad Electrical Engineering Institute, Leningrad, USSR  
Instruments And Experimental Techniques, Vol. 16, No. 5, pp 1350-1351  
(10/1974)Trans. From: Priroda i Tekhnika Eksperimenta 5, 93-94  
(September-October 1974)

The circuit of a shaper is considered that produces pulses across a capacitive load and whose circuit includes an additional capacitor and resistor which permit the shaping of pulses with a length shorter than the time required to restore the controlling properties of the commutating instrument. 3 Refs.

Primary Keywords: Pulse Shaping Circuit; Rectangular Pulse; Capacitive Load; Short Pulse; Switch Recovery

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7104

(ENERGY STORAGE, INDUCTIVE)

(Inductors)

CALCULATION OF TOROIDAL INDUCTIVE ACCUMULATORS WITH A D-CROSS SECTION FROM PARAMETERS OF A DISCHARGE PULSE AND OF THE CHARGING DEVICE

I.A. Ivanov, V.V. Sizov and V.A. Trukhin

Moscow, USSR

Journal Of Applied Mechanics And Technical Physics, Vol. 18, No. 4, pp 673-679 (08/1977)

Trans. From: Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki 18, 55-61 (July-August 1977)

One method of increasing the power of the discharge pulse of an inductive accumulator is based on the use of a scheme with a switch-over. With charging, the sections of the accumulator are connected in series and with discharge, in parallel. In this case, rigid requirements are imposed on the symmetry of the cross section. Such requirements are satisfied by constructions with a toroidal field (another of their advantages is the absence of scattering fields). The internal rectilinear section of the coil is subject to compression in the direction of the longitudinal axis and to longitudinal elongation. In a construction with such a profile, with uniform equalization of the radial compression, the action of the bending moments is everywhere completely excluded. The form of the profile, with which the winding does not undergo the action of the bending moments, is called a D-section. A construction with a D-section is optimal with respect to energy capacity. Therefore, in comparison with other variants of toroidal constructions in coils with a D-section, the specific parameters are found to be the highest. 2 Refs.

Primary Keywords: Toroidal Inductive Accumulators; D-cross Section; Discharge Pulse; Toroidal Field; Optimal Mechanical Strength; Optimal Energy Capacity

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7105

(POWER CONDITIONING)

(Pulse Transformers)

CO/SUB 2/ LASER HIGH-VOLTAGE POWER SUPPLY BASED ON A PULSED AUTOTRANSFORMER

V.V. Apollonov, A.I. Barchukov, S.I. Dargzhavin, I.G. Kenonov, K.M. Firsov, Yu.A. Shakir, V.A. Yamashchikov, A.V. Krivonosenko, S.S. Pel'tsman and B.V. Samkin

Physics Institute, Academy of Sciences of the USSR, Moscow, USSR

Instruments And Experimental Techniques, Vol. 21, No. 6, pp 1602-1604  
(12/1978)Trans. From: Priroda i Tekhnika Eksperimenta 6, 131-133  
(November-December 1978)

We describe the construction of a high-voltage system with a pulsed autotransformer for the supply of a CO/sub 2/ laser with transverse discharge. The system parameters are U/sub max/ = 150 kV, I/sub max/ = 20 kA, and the length of the discharge current I/sub off/ = 1 microsecond. Several models were tested, with different coil cross sections, transformation coefficients, and numbers of turns in the windings. Stable glow discharges were obtained in gas mixtures CO/sub 2/ 2/; N/sub 2/ 2/; He = 1:2:3, 1:2:2, 1:2:1.5 in a volume 60 x 500 mm at energy inputs up to 400 J/litter atm. 4 Refs.

Primary Keywords: Pulsed Autotransformer; Transverse Discharge; 150 kV Voltage; 20 kA Current; Maximum Energy-Transfer; Efficiency; Minimum Energy Release Duration; < 10W Instantaneous Power; < 1 Microsecond Current Duration; < 40 J/litter atm. Energy Input

Secondary Keywords: CO/sub 2/ Laser Power Supply

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7106

(ELECTROMAGNETIC FIELD GENERATION)

(Magnetic)

COMPRESSION OF MAGNETIC FIELD IN AN IMPLoding SPHERICAL CAVITY

V.K. Bodulinskiy and Yu.A. Ryzhikov

Moscow, USSR

Journal Of Applied Mechanics And Technical Physics, Vol. 11, No. 6, pp 991-993 (12/1970)

Trans. From: Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki 11, 114-115 (November-December 1970)

The equations describing the compression of a magnetic field, produced by a system of meridional currents, in an imploding spherical cavity are solved in the present communication. 4 Refs.

Primary Keywords: Flux Compression; Plane Parallel Conducting Surfaces; Cylindrical Geometry; Design Optimization

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7107

(BREAKDOWN STUDIES)

(Gas, Electrical)

CONTRACTION OF THE DECAYING PLASMA IN A NITROGEN DISCHARGE

V.Yu. Baranov, P.I. Vyskalo, A.P. Napartovich, V.G. Niz'nev, S.V. Piguil'skiy and A.N. Sterostin

Soviet Journal Of Plasma Physics, Vol. 4, No. 2, pp 201-205 (04/1978)

Trans. From: Fiz. Plazmy 4, 358-365 (March-April 1978)

The stability of a nitrogen glow discharge plasma in a static electric field has been studied. Gas-dynamic effects in the discharge gap were studied with an interferometer. Experimental results on the electrode effects in pulsed discharges are reported. The discharge was photographed during the transition from the homogeneous phase to an arc, using an LV-03 time-loop unit. The experimental data on the time of this transition are compared with numerical calculations. The model used for these calculations incorporates stepwise ionization from metastable electronic states of the molecule and the time evolution of the gas density in the discharge gap. The rate constants for the elementary processes involving electrons are calculated with a non-Maxwellian electron velocity distribution which is a function of E/n and the average vibrational temperature of the gas. It is concluded that the time required for the discharge contraction is very sensitive to the gas-dynamic perturbations, the stepwise ionization, and the variation with vibrational temperature of the rate constants for the elementary processes. 15 Refs.

Primary Keywords: Nitrogen Discharge; Glow Discharge; Discharge Contraction; Static E-field; Gas Density; Electrode Effects; Experiment; Theory

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7111

(BREAKDOWN STUDIES)

(Liquid, Electrical)

DEVELOPMENT OF A PULSE DISCHARGE IN LIQUIDS

V.S. Konev'kov

Soviet Physics-Technical Physics, Vol. 6, No. 8, pp 691-699 (02/1971)

Trans. From: Zhurnal Tekhnicheskoi Fiziki 31, 946-960 (August 1961)

We show experimentally that pulse discharges in polarized (distilled water) and nonpolarized (transformer oil) liquids are the result of a leader process. In a low resistance discharge circuit the leader develops continuously. In high resistance discharge circuit a stepwise movement of the leader from electrode to electrode is noted. In oil a secondary discharge takes place after the completion of the leader stage. We present a qualitative analysis of the phenomena under study. 28 Refs.

Primary Keywords: Liquid Breakdown; Water Breakdown; Transformer Oil Breakdown; Leader Process; Continuous Leader; Photographic Diagnostic

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7113

(BREAKDOWN STUDIES)

(Liquid, Electrical)

DISCHARGE PHENOMENA IN LIQUIDS

I.S. Stokol'nikov and V.Yu. Shcheglov

Soviet Physics-Technical Physics, Vol. 10, No. 9, pp 1307-1313  
(03/1966)

Trans. From: Zhurnal Tekhnicheskoi Fiziki 35, 1692-1700 (September 1965)

In the present work we have investigated the development of discharges in transformer oil (of GOST strength 45 to 56 kV), distilled water (gamma = 1E-5/ohm cm.), and ethyl alcohol (industrial grade) under a pulsed voltage in rod-to-plane (r-p) and r-p and rod-to-rod (r-r) geometries. The interelectrode gap was varied from 50 to 165 mm. The voltage pulse length was varied from 1.5 to 70 microseconds at the amplitude corresponding to 50% of the discharge value. 10 Refs.

Primary Keywords: Liquid Breakdown; Water Breakdown; Transformer Oil Breakdown; Alcohol Breakdown; Rod-rod Gap; Rod-plane Gap; Breakdown Development; Photographic Diagnostic

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7115

(BREAKDOWN STUDIES)

(Gas, Electrical)

GAS-DISCHARGE CONTRACTION

E.A. Muratov, I.G. Persiantsev, V.D. Pis'mennyi and A.I. Rakhimov

Nuclear Physics Scientific-Research Institute, Moscow State University, Moscow, USSR

High Temperature, Vol. 13, No. 3, pp 592-594 (06/1975)

Trans. From: Teplofizika Vysokikh Temperatur 13, 654-656 (May-June 1975)

A diffuse gas discharge in a cylindrical tube contracts as the current increases; the degree of contraction is dependent on many detailed characteristics such as the degree of ionization, the charged particle recombination mechanism, and the electronegative impurity concentration, but the usual contraction mechanism for a long cylindrical tube is radial displacement of the heated gas from the axis towards the periphery. This is due to the radial temperature gradient, which itself arises from the surface heat loss. To establish the importance of the heating in the contraction, we made some experiments with a glass tube filled with a gas carrying a normal glow discharge, and the pressure, current, and voltage were chosen such that the discharge filled the entire cross section. Such a discharge will burn in a stable fashion if the circuit contains a ballast resistance whose value is governed by the discharge current, and which usually has to be much greater than the plasma resistance. In that case, any current fluctuation in the plasma results in a change in the balance of potential differences between the ballast resistance and the discharge tube, which tends to stabilize the situation. 7 Refs.

Primary Keywords: Gas Discharge; Diffuse Discharge; Discharge Contraction; Current Dependence; Impurity Concentration

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7116  
(POWER CONDITIONING)  
(Pulse Transformers)  
GENERALIZED CHARACTERISTICS OF THE OSCILLATORY SYSTEM OF A TUNED HIGH-VOLTAGE TRANSFORMER FOR SUPPLYING HIGH-CURRENT PULSED ACCELERATORS  
S.M. Mezentssev, V.I. Mikhailov and S.V. Naek  
All-Union Institute, Moscow, USSR  
Instruments And Experimental Techniques, Vol. 17, No. 6, pp 1559-1562 (12/1974).  
Trans. From: Priroda i Tekhnika Eksperimenta 6, 14-17 (November-December 1974)

Generalized characteristics are given for the coupled circuits of a tuned high-voltage transformer, which enables one to calculate the circuit parameters when there is nonlinear loading, which is typical of high-current pulsed electron accelerators. 6 Refs.  
Primary Keywords: Tuned Transformer; Nonlinear Load; Electron Accelerator; Theory; Experiment; Switching Considerations  
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7117  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
HIGH-CURRENT PULSED ELECTRON GUN BASED ON AN ELIT-1 ACCELERATOR  
V.A. Denilichev and V.E. Khodkevich  
Physics Institute Academy of Sciences of the USSR, Moscow, USSR  
Instruments And Experimental Techniques, Vol. 14, No. 3, pp 110-113 (06/1971).  
Trans. From: Priroda i Tekhnika Eksperimenta 3, 157-158 (May-June 1971)  
The construction of an electron gun based on an ELIT-1 accelerator is proposed which allows pulsed electron current of up to 1 kA having a current-pulse length of 10 nsec to be obtained at an accelerating voltage of 1 MeV. 2 Refs.

Primary Keywords: Electron Gun; ELIT-1 Accelerator; <1 KA Pulsed Electron Current; 10 nsec Current-pulse Length; 1 MeV Accelerating Voltage; Insulator Dielectric Strength  
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7120  
(ELECTROMAGNETIC FIELD GENERATION; PULSE GENERATORS)  
(Magnetic; Flux Compression)  
MAGNETIC CUMULATION  
A.D. Acemicien, R.Z. Sakharov, R.Z. Lyudskov, E.M. Smirnov, Yu.I. Plyushchev, A.I. Pavlovskii, V.K. Chernyshev, E.A. Fackistova, E.T. Zharinov and Yu.A. Zysin  
Soviet Physics-Doklady, Vol. 10, No. 11, pp 1045-1047 (05/1966).  
Trans. From: Doklady Akademii Nauk SSSR 165, 65-68 (November 1965)  
Any explosion is an abundant source of mechanical and thermal energy. In 1951 Sakharov proposed a possible way of converting this energy to magnetic form together with the general lines of devices for producing very strong fields and currents by the explosive deformation of current-carrying conductors. The process has been called magnetic cumulation. Here we describe briefly two typical generators of this type: the MK-1 (which employs compression of an axial magnetic field) and the MK-2 (ejection of the magnetic field from a solenoid and subsequent compression by the walls of a coaxial line). 3 Refs.

Primary Keywords: Flux Compression; Magnetic Cumulation; Axial Magnetic Field Compression; Coaxial Line Mill Compression; Aluminum Tube  
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7121  
(PULSE GENERATORS; ENERGY STORAGE, CHEMICAL)  
(Flux Compression; Flux Compression Generators)  
MAGNETOIMPLOSIVE GENERATORS  
A.D. Sakharov  
Soviet Physics Uspekhi, Vol. 9, No. 2, pp 294-299 (10/1966).  
Trans. From: Usp. Fiz. Nauk 88, 725-734 (April 1966)  
Several recent experimental and theoretical papers are devoted to the use of explosions to produce ultrastrong magnetic fields. The same topic was also the subject of a recent international conference (Rome, September 1965). In the USA and the USSR, fields of 15-25 million gauss were attained in individual experiments. Compact weaker fields 15-25 million gauss can be attained relatively simply. In this article we describe the physical and structural principles of magnetoimplosive generators and their characteristics, and touch upon problems involving their application. 10 Refs.  
Primary Keywords: Flux Compression Generator; Explosive Driven; Detonation Lens; Lozenge; Cylindrical Geometry; Theory  
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7122  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
ONSET OF THE IONIZATION INSTABILITY IN A PERIODIC, EXTERNALLY SUSTAINED DISCHARGE IN NITROGEN AND A  $N_2/CO_2$  MIXTURE AT HIGH PRESSURES  
E.A. Muratov, V.D. Pis'mennyi and A.T. Rakhimov  
Scientific Research Institute Of Nuclear Physics, Moscow State University, Moscow, USSR  
Soviet Journal Of Plasma Physics, Vol. 3, No. 2, pp 230-232 (04/1977).  
Trans. From: Izv. Plazmy 3, 405-408 (March-April 1977)  
When an externally sustained discharge is operated in a train of pulses in a high-pressure gas, the maximum specific energy which can be pumped into the gas is quite different from that in the case of single-pulse excitation. The time evolution of the instability which limits the number of pulses of a homogeneous, externally sustained discharge in nitrogen is different from that in an  $N_2/CO_2$  mixture. The difference is attributed to an essential difference in the instability. 9 Refs.  
Primary Keywords: Gas Discharge; Nonsustained Discharge; Breakdown Instability; Temporal Resolution; Chang Electrodes;  $N_2/CO_2$  Mixture  
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7123  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
SOME CHARACTERISTICS OF A DOUBLE, HOLLOW CATHODE WITH THE PULSED SUPPLY OF THE CATHODE-EXCITER  
Yu.B. Anishev and V.N. Muzgin  
Journal Of Applied Spectroscopy, Vol. 23, No. 3, pp 1153-1156 (09/1974).  
Trans. From: Zhurnal Prikladnoi Spektroskopii 21, 414-418 (September 1974)

The use of a double, hollow cathode with separated zones for evaporation and excitation made it possible to obtain a quantity of new data on the mechanism for a discharge in hot and cooled hollow cathodes. In connection with this it was of interest to use the method of the independent control of the processes for the evaporation of the sample material and for the excitation of its spectrum to study such little investigated variations of the discharge in a hollow cathode as the pulsed discharges. In this study a discharge tube was used with a double hollow cathode, analogous to that described earlier. The cathode-evaporator was supplied by means of a direct current and the cathode-exciter was supplied by a pulsed current having an amplitude of from 0.5 to 10 amps for a following frequency of the pulses of from 20 to 1000 Hz. 12 Refs.  
Primary Keywords: Helium Gas Breakdown; Optical Diagnostic; Emission Spectrum; Hollow Cathode; Impulse Voltage  
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7124  
(SWITCHES, OPENING)  
(Explosive Fuses)  
SWITCHING CHARACTERISTICS OF EXPLOSIVE DISCONNECTORS WITH RAPID DESTRUCTION OF THE CONTACT ELEMENT  
E.A. Azizov, N.A. Akhmerov, K.I. Kozorezov and V.V. Semchenko  
USSR Journal Of Applied Mechanics And Technical Physics, Vol. 19, No. 4, pp 456-459 (08/1978).  
Trans. From: Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki 4, 56-59 (July-August 1978)

The extension of the range of application of inductive stores, including their use to obtain high-power electron beams and to supply plasma-dynamic systems with energies greater than 1 MJ, involves the design of ultra-low-resistance (approximately  $10^{-6}$  ohm) switches for power levels of 1E11 - 1E12 W and switching rise times of  $10^{-6}$  -  $10^{-7}$  sec. It would seem that such switches can be designed using the principles of the rapid destruction of a contact element by an explosive charge. However, a number of problems arise in this direction which can only be solved experimentally: 1) What should the length of the destroyed part of the contact for a given switching voltage be, and how does it depend on the current and geometry? 2) What is the minimum switching time determined by the interaction between the explosion products and the arc which occurs at the points of destruction? 3) The relation between the ratio of the masses of the explosive charge  $M_{sub}$  and the contact junction  $m$ ,  $\alpha = M_{sub}/m$ , and the switching power for a given thermal stability of the current-carrying elements. In this paper we present the results of a study of the switching characteristics of some versions of explosive switches (ES) with rapid destruction of the contact element. 3 Refs.  
Primary Keywords: Load Circuit Characteristics And Parameters; Rapid Contact Element Destruction; Ultra-low-resistance Switches; 1E11 - 1E12 W Power Levels;  $10^{-6}$  -  $10^{-7}$  sec Switching Rise Times; Explosive Switches  
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7125  
(BREAKDOWN STUDIES; SWITCHES, OPENING)  
(Exploding Wires; Explosive Fuses)  
VOLTAGE WAVEFORM FOR EXPLODING WIRES  
V.L. Budovich and I.P. Kuzhakin  
Moscow Power Institute, Moscow, USSR  
Soviet Technical Physics Letters, Vol. 1, No. 11, pp 440-441 (11/1975).  
Trans. From: Pis'ma Zhurnal Tekhnicheskoi Fiziki 1, 1023-1026 (November 1975)

It is shown elsewhere that a conductor through which a high current flows can be destroyed by PMO instabilities. The development of such instabilities in a liquid conductor leads, in the final analysis, to the formation of numerous breaks in the conductor in which electric arcs are ignited. Ignition of each arc raises the voltage across the conductor by an increment to a value not less than the sum of the voltage drop in the arc, this effect being manifested as a voltage step. The number of such breaks and arcs increases rapidly, and after the first arc is ignited, the voltage across the exploding wire increases rapidly. To be able to record the steps corresponding to the ignition of arcs in the breaks, it is necessary to measure the voltage with high time resolution. The experiment has been performed here in the following manner: When current begins to flow from a 0.0156 F capacitor bank through a wire connected in series with a 0.34 ohm ballast resistor, a signal is applied to a GS-27 generator, and this delays the pulse triggering the GS-2 oscilloscope. The delay is chosen approximately equal to the time between the start of the current flow and the very rapid growth of the voltage. 3 Refs.  
Primary Keywords: Exploding Wire; Voltage Measurement; High Temporal Resolution; Voltage Steps; Magneto-hydrodynamic Instability; Wire Construction  
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7126  
A NANOSECOND PULSE GENERATOR FOR SPARK CHAMBERS  
A.I. Alikhanov, A.S. Aleksanyan, G.A. Vorob'ev, R.L. Kabelov and V.K. Kroi  
FID, Wright-Patterson AFB, OH  
No. FID-10(PST)-1848-79, 17p (12/1979).  
Availability: AD-A087 876/9  
NTIS  
No abstract available.  
Primary Keywords: Pulse Generators; Spark Chambers; Magnetic Fields; Translations; USSR  
Secondary Keywords: Strip Lines; Arkad'yev Marx Generators; Coaxial to Strip Crossover; NTISDODXA; NTISFNUR

7130  
(ENERGY STORAGE, INDUCTIVE; ENERGY STORAGE, INDUCTIVE)  
(Inductors; Systems)  
AN INDUCTIVE STORE WITH ELECTROMAGNETIC CURRENT MULTIPLICATION  
A.V. Ivlev, A.S. Kibardin, A.V. Komin, V.G. Kuchinskii, K.M. Lobanov  
and Yu.A. Morozov  
D.V. Efremov Institute, Leningrad, USSR  
Electric Technology USSR, Vol. 100, No. 1, pp 24-33 (01/1980).  
Trans. From: Elektrichestvo 100, 47-49 (1980)  
An inductive energy store is described in which electromagnetic  
current multiplication is used to increase the output current to the  
load without increasing pump current. A toroidal geometry is chosen  
with a circular coil utilized. A shield is imposed to alter the value  
of the store at an appropriate moment to increase current without  
elaborate switching systems. High efficiency is reported. 2 Refs.  
Primary Keywords: Inductive Store; Electromagnetic Current  
Multiplication; 65% Efficiency; Fewer Switches;  
Greater Mechanical Strength; Mechanical  
Multiplication; Simpler Commutation System; Ensured  
Electric Strength; Increased Metal Mass  
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7134  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
DEVELOPMENT OF A SPARK DISCHARGE. I  
S.I. Andreev and B.I. Orlov  
Soviet Physics-Technical Physics, Vol. 10, No. 8, pp 1097-1101  
(02/1966).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 35, 1411-1418 (August 1965)  
It is shown that the electrical phenomena and the expansion of a  
spark channel during the first current half-cycle can be described  
with good accuracy if it is assumed that the specific electrical  
conductivity of the plasma remains constant during this time  
interval. 16 Refs.  
Primary Keywords: Spark Discharge; Constant Electrical Conductivity;  
Spark Channel; Channel Expansion; Power Line  
Frequency; Theory; Hydrodynamic Theory  
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7135  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
DEVELOPMENT OF HIGH-CURRENT ELECTRON ACCELERATORS  
M.V. Babykin and A.V. Bartov  
I.V. Kurchatov Institute of Atomic Energy, Moscow, USSR  
Soviet Technical Physics Letters, Vol. 1, No. 3, pp 123-124 (03/1975).  
Trans. From: Plasma Zhurnal Tekhnicheskoi Fiziki 1, 257-262 (March  
1975)  
To realize the suggestions advanced by Zavoiskii, Winterberg, and  
others of initiating thermonuclear reactions by heating a dense  
target with a beam of relativistic electrons using inertial  
confinement, the power required is  $1E15-1E16$  W; when a heavy temper  
is used to compress the target, the power is approximately  $3E14$  W;  
the beam current is  $1E17-1E8$  A, and the heating time is  
approximately 10 nsec. When the voltage pulse used to accelerate the  
electrons is shaped by a transmission line, the power  $W$ , and the  
total line current  $I$  are determined by the allowable field  $E$  in the  
dielectric and by the dimensions of the line. To obtain large power  
it is necessary to use large and expensive systems and optimization  
is important. 11 Refs.  
Primary Keywords: Electron Accelerators; Relativistic Electrons;  
Multiple Breakdown; 5 nsec Rise Time; Cylindrical  
Line  
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7136  
(INSULATION, MATERIAL; INSULATION, MATERIAL)  
(Liquid; Solid)  
DIELECTRIC MATERIALS FOR HIGH-VOLTAGE PULSE GENERATORS  
B.A. Demidov, V.A. Petrov and S.D. Fanchenko  
Soviet Physics-Technical Physics, Vol. 17, No. 1, pp 124-126 (07/1972).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 42, 179-181 (January 1972)  
Experiments carried out to study the electric strength behavior  
of transformer oil, distilled water, and polyethylene show  
250-nV pulses 0.35 microsecond long are described. The dielectric  
materials are compared on the basis of the parameter  $\gamma$ , the  
energy flux per unit cross section of the dielectric. 9 Refs.  
Primary Keywords: Transformer Oil; Distilled Water; Polyethylene;  
Dielectric Strength; Impulse Voltage  
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7138  
(PULSE GENERATORS)  
(Flux Compression)  
FLUX-COMPRESSION-MAGNETIC GENERATOR WITH AN INDUCTIVE LOAD  
I.I. Divnov, Yu.A. Gus'kov, N.I. Zotov, O.P. Karpov and B.D.  
Khrustofyov  
Institute of Earth Physics, Academy of Sciences of the USSR  
Combustion Explosion and Shock Waves, Vol. 12, No. 6, pp 841-843  
(12/1976).  
Trans. From: Fizika Goreniya i Vozvys 12, 959-962 (November-December  
1976)  
The authors describe a design for an explosively driven magnetic  
flux compression generator driving an inductive load through a  
transformer. Performance data are presented with conversion  
efficiency included. The very flux is encountered is discussed. A  
qualitative analysis of the coupling transformer is given. 6 Refs.  
Primary Keywords: Flux Compression Generator; Explosively Driven;  
Transformer; Coupling; Inductive Load; Conversion  
Efficiency  
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7142  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
HIGH-CURRENT, MICROSECOND-RANGE RELATIVISTIC ELECTRON BEAM  
B.A. Demidov, M.V. Ivkin, V.A. Petrov and S.D. Fanchenko  
Soviet Physics-Technical Physics, Vol. 20, No. 12, pp 1597-1600  
(06/1976).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 45, 2568-2573 (December 1975)  
An experimental study is reported of the possibility of producing  
a microsecond, kiloampere pulse of relativistic electrons in an  
accelerator with a gap consisting of a point cathode and a plane  
anode. Because of the radial beam divergence in this configuration,  
the electron current density near the anode is reduced. This  
reduction makes it possible to prolong the spontaneous breakdown of  
the accelerating gap. The spectrum of accelerated electrons is  
studied. The absolute energy calibration is carried out with a beta  
source. 7 Refs.  
Primary Keywords: Delayed Accelerating Gap Breakdown; 1 MV Pulse  
Voltage Generator; Accelerating Tube; Relativistic  
Electron Beam; Microsecond Kiloampere Pulse;  
Electron Current Density Reduction; Inhomogeneous  
Magnetic Field  
Secondary Keywords: Radial Beam Divergence  
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7145  
(ENERGY STORAGE, INDUCTIVE; ENERGY STORAGE, CAPACITIVE)  
(Systems; Capacitor Banks)  
INDUCTIVE STORAGE BANK FOR DYE-LASER PUMPING  
I.I. Artamonov, B.A. Barikhin, V.V. Borovkov and V.I. Kashintsov  
Soviet Physics-Technical Physics Letters, Vol. 4, No. 12, pp 573  
(12/1978).  
Trans. From: Plasma Zhurnal Tekhnicheskoi Fiziki 4, 1416-1416  
(December 1978)  
In this letter we describe an experimental study of the pumping of  
an ethalon solution of the dye Rhodamine 6G. The experiments are  
carried out in a system in which energy is supplied to the discharge  
in a coaxial flash lamp in two ways: directly from the capacitive  
storage bank, or by transfer of the energy stored in the capacitor  
bank to an inductance. In the second case the same amount of energy  
as in the first case is then transferred from the inductance to the  
flash lamp with no change in the parameters of the discharge circuit.  
5 Refs.  
Primary Keywords: Inductive Energy Storage; Increased Laser Output  
Energy; Comparison With Capacitive Storage  
Secondary Keywords: Dye-Laser Pumping  
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7146  
(SWITCHES, OPENING)  
(Mechanical)  
INFLUENCE OF A DIELECTRIC MEDIUM ON THE CHARACTERISTICS OF A HIGH-SPEED  
EXPLOSIVE CIRCUIT BREAKER  
E.A. Azizov, N.A. Akhmerov and V.A. Yagov  
Soviet Technical Physics Letters, Vol. 2, No. 4, pp 121-123 (04/1976).  
Trans. From: Plasma Zhurnal Tekhnicheskoi Fiziki 2, 316-321 (April  
1976)  
In an explosive circuit breaker that uses shunting of the  
disconnect arc, a section of the current conductor is destroyed with  
an explosive. The destroyed section is a hollow cylinder, along the  
axis of which the explosive charge is located. The space between the  
charge and the wall of the destroyed element is filled with  
dielectric. 1 Refs.  
Primary Keywords: Explosive Circuit Breaker; Mechanical Spreading;  
Current Conductor; Dielectric Medium Influence;  
Plasma Pressure  
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7150  
(BREAKDOWN STUDIES)  
(Vacuum; Electrical)  
MOTION OF THE CATHODE SPOT OF A VACUUM ARC  
V.A. Nemchinskii  
All-Union Institute, Moscow, USSR  
Soviet Physics-Technical Physics, Vol. 24, No. 7, pp 767-771 (07/1979).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 49, 1379-1385 (July 1979)  
A mechanism is proposed for explaining the motion of the cathode  
spot of a vacuum arc. The spot velocities estimated on the basis of  
this mechanism agree with the experimental results for spots on  
tungsten, copper, and mercury. 22 Refs.  
Primary Keywords: Vacuum Arc; Cathode Spot; Spot Motion; Theory;  
Comparison With Experiment; Several Cathode Materials  
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7154  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
OBTAINING HEAVY CURRENT ELECTRON BEAMS (SURVEY)  
V.P. Smirnov  
Instruments And Experimental Techniques, Vol. 20, No. 2, pp 357-364  
(04/1977).  
Trans. From: Priroda i Tekhnika Eksperimenta 2, 7-31 (March-April 1977)  
The most important results of the development of heavy current  
accelerating with  $\approx 10$  kA current and  $\approx 100$  nsec pulse duration are  
collected in this survey and their main elements: the pulse supply  
sources based on capacitive storage, the shaping line dielectrics,  
the shaping and transport lines, the shaping line commutators, the  
inductive storage, the accelerator tube insulators, and the diodes,  
are described. Certain possible accelerator schemes with energy  
storage in a 2-1 MJ beam and the power approximately  $1E14$  W are  
considered. 160 Refs.  
Primary Keywords: 10 kA Heavy Current Accelerators;  $\approx 100$  nsec Pulse  
Duration;  $1E13$  W Maximum Beam Power; 2 ms Beam  
Energy; Relativistic Electron Beams  
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7158  
(PARTICLE BEAMS, ELECTRON; BREAKDOWN STUDIES)  
(Generation: Vacuum, Electrical)  
PREPULSE DISCHARGES IN THE MODES OF A HIGH-CURRENT ACCELERATOR WITH A DOUBLE SHAPING LINE

V.A. Tsukerman, I.A. Troshkin, K.F. Zelenskii and N.V. Baikin  
Soviet Technical Physics Letters, Vol. 5, No. 2, pp 67-68 (02/1979).  
Trans. From: Pis'ma Zhurnal Tekhnicheskoi Fiziki 5, 169-172 (February 1979)

High-current accelerators with vacuum diodes with double shaping lines have recently been adopted widely for generating short pulses of relativistic electrons and bremsstrahlung. Such lines are usually charged with a pulsed Marx system. During charging a preliminary high-voltage pulse appears across the electrodes of the vacuum diode. We have found the prepulse useful in a comparatively small high-current generator of fast electrons and bremsstrahlung, the GONG generator. 7 Refs.

Primary Keywords: E-beam Generator; Prepulse Discharges; High-current Accelerator; Double Shaping Line; Vacuum Diodes; GONG Generator

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7159  
PULSE CURRENT GENERATOR

M.I. Kozlov and M.S. Rudenko  
FTD, Wright-Patterson AFB, OH  
No. FTD-ID(PS)-1936-79, 8p (12/1979).  
Availability: AD-A084 534/7  
NTIS

No abstract available.  
Primary Keywords: Pulse Generators; Electric Generators; High Voltage.  
Patents; Translations  
Secondary Keywords: Foreign Technology; NTISDODXA; NTISFNUR

7165  
(SWITCHES, CLOSING)  
(Surface Discharge, Electrical)  
TIME CHARACTERISTICS OF A MULTICHANNEL GRAZING-DISCHARGE HIGH-VOLTAGE SWITCH

G.I. Belyaev, P.N. Dashuk and M.A. Chernov  
M.I. Kalinin Leningrad Polytechnical Institut., Leningrad, USSR  
Soviet Physics-Technical Physics, Vol. 24, No. 5, pp 578-581 (05/1979).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 49, 980-986 (May 1979)

The temporal characteristics of multichannel grazing-discharge switches capable of repeatedly switching currents up to 1E6 A have been tested experimentally. Short delay times and switching times are found (1E-7 sec). In addition, the spread in these times is small (1E-8 sec). The characteristics of the ignition device and the magnitude and polarity of the main voltage affect the controllability of the switch. 9 Refs.

Primary Keywords: Multichannel Grazing-discharge Switches; 1E6 A Currents; Short Delay Times; Fast Rise Time, Low Inductance

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7166  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
TWO-CHAMBER HEAVY-CURRENT HIGH-VOLTAGE SWITCH

O.G. Bespalov, A.S. Knyazev, A.I. Nastyukha, P.A. Smirnov and A.N. Udovankin  
Instruments And Experimental Techniques, Vol. 18, No. 1, pp 125-126 (02/1975).  
Trans. From: Priboiy i Tekhnika Eksperimenta 1, 113-114 (January-February 1975)

A description is given of a switch that will handle currents of about 500 kA at 1-20 kV with a length of 5-100 microseconds for the first half-cycle in the pulse and a repetition frequency of 0.1 Hz. The device works with residual gas at 3 - 8E-2 Torr. A study has been made of the gas composition. 5 Refs.

Primary Keywords: 1-20 kV Switch; 500 kA Currents; Hollow Cold Cathode Arc Switches; Two Chamber Switch; Copper Anode

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7167  
(BREAKDOWN STUDIES)  
(Vacuum, E-beam)  
VAPOR PRESSURE AND LOCAL ANODE TEMPERATURE IN ELECTRICAL BREAKDOWN IN VACUUM BY AN ELECTRIC BEAM

V.I. Mikhailov and M.I. Troshkov  
Soviet Physics-Technical Physics, Vol. 15, No. 1, pp 169-170 (07/1970).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 46, 212-215 (January 1970)

Electrical breakdown in vacuum can result from local heating of the anode. The anode is heated by an artificially produced beam of electrons. The increment of electron current in the gap is measured, and the vapor pressure of material from the stainless steel anode,  $p_{\text{sub}}/1E19$  cm, is determined. A local anode temperature  $T$  approximately 3100-3200 Deg K, is calculated from other experimental parameters. The order of magnitude of the values is close to that obtained in other work. 6 Refs.

Primary Keywords: E-beam Initiated Electrical Breakdown; Vacuum Breakdown; 3100-3200 Deg K; Local Anode Temperature; Anode Material Evaporation; 1E19 cm/cm Evaporation Vapor Density

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7168  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
A SIMULATION APPROACH TO HIGH AVERAGE POWER REPETITIVELY PULSED SWITCH TESTING

R.W. Clark  
Maxwell Labs Inc, San Diego, CA 92123  
IEEE Transactions On Industrial Electronics and Control Instrumentation, Vol. IECI-23, No. 1, pp 98-101 (02/1976)

A technique is discussed which can be used to simulate the very high average power environment encountered when high power switches are operated in a repetitively pulsed mode. An operational test facility is described which has been used to test spark gap switches at voltages up to 80 kV, pulse repetition rates up to 500 pps, and simulated average power levels of several megawatts. The power consumed in the test facility depends on the power simulated and the voltages used in the test circuit. Typically, the electrical duty experienced by a switch transferring several megawatts average power can be provided with a few hundred kilowatts average power using the simulation concept described here. 4 Refs.

Primary Keywords: Spark Gap; Simulation; Low Power Operation; High Power Simulation; Repetitive Power Simulation

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7169  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
A MODEL FOR THE STUDY OF SWITCHING-SURGE BREAKDOWN OF LONG AIR GAPS

E.J. Los  
General Electric Co, Pittsfield, MA 01201  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-97, No. 6, pp 2392-2396 (12/1978)

A model of the discharge process leading to the switching surge fire hover of long air gaps is presented. This model is based on a non-thermal equilibrium model of the discharge channel. Depending on temperature and current, the volt-ampere characteristics of the discharge channel simulation behave either like a resistor or a zener diode. This channel simulation is combined with an electric field calculation to produce a breakdown model for arbitrary gap geometries and applied voltage waveforms. The model is currently implemented on a minicomputer system. 34 Refs.

Primary Keywords: Non-thermal Equilibrium Model; Discharge Channel; Resistor Behavior; Zener Diode Behavior; Arbitrary Gap Geometries; Arbitrary Voltage Waveform

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7170  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Miscellaneous)  
A DOUBLE FREQUENCY METHOD FOR THE DETERMINATION OF THE VOLTAGE DEPENDENT CAPACITANCE VARIATION OF COMPRESSED GAS CAPACITORS

J. Zinkenbagen  
Physikalisch Technische Bundesanstalt, Braunschweig, FRG  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-98, No. 1, pp 304-309 (02/1979)

This paper describes the development of a double frequency measurement method by the aid of which the voltage dependent capacitance variation of high voltage compressed gas capacitors is determined with most methodical exactitude. The measurement method makes use of a modified Schering-bridge and of a specially developed turning device for bridge balancing, the selectivity of which is extremely high, and new in the range of low frequency measurement techniques. 6 Refs.

Primary Keywords: Compressed Gas Capacitor; Schering-bridge; Very High Selectivity; Double Frequency; Electrostatic Force

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7171  
(SWITCHES, OPENING)  
(Mechanical)  
THE TRANSIENT RECOVERY VOLTAGE APPLICATION OF POWER CIRCUIT BREAKERS

R.G. Colclaser  
University of Pittsburgh, Pittsburgh PA  
IEEE Transactions On Power Apparatus And Systems, Vol. 91, No. 5, pp 1941-1947 (10/1972)

The proposed transient recovery voltage standard for high voltage circuit breakers will specify application requirements on a recovery voltage basis. This paper studies the inherent circuit parameters required to generate the required TRV envelope. A simplified application procedure is developed based on miles to the first line discontinuity and the number of lines connected on the bus side of the circuit breaker. 12 Refs.

Primary Keywords: Transient Recovery Voltage; Standard; Application; Current Rating; Voltage Rating

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7172  
(PULSE GENERATORS)  
(Plumlein Lines)  
THE USE OF A PLANAR THREE-ELECTRODE PLUMLEIN LINE FOR THE SUPPLY OF SYMMETRIC STREAMER CHAMBERS

V.A. Mikhailov and T.A. Lomtadze  
Institute of Physics, Academy of Sciences of the Georgian SSR, Tbilisi, USSR

The paper suggests a principally new supply circuit of the symmetric streamer chamber, applicable for the supply of the multilayer system of the spark gaps by a start-down voltage as well. The photos of the streamer registered in the chamber having the sensitive volume (100 x 75 x 10) x 2 sq cm, are given. 4 Refs.

Primary Keywords: Blumlein Line; Double Forming Line

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7173  
(REVIEWS AND CONFERENCES)  
(Conferences)  
IEEE AND INTERNATIONAL PULSED POWER CONFERENCE DIGEST OF TECHNICAL PAPERS

A.H. Guenther (1) and M. Kristiansen Eds (2)  
(1) AFRL, Kirtland AFB, NM 87117  
(2) Texas Tech University, Lubbock, TX 79409  
(06/1979)

This conference record contains 104 papers (4 are included as abstracts only), 102 of which are referenced individually in the bibliography. Topics include energy storage, pulse generation, pulse switching, particle beam generation and transport, applications, and reviews of the state-of-the-art. 0 Refs.

Primary Keywords: Energy Storage; Pulse Generation; Pulse Shaping; Switching; Particle Beam Generation And Transport; Applications

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7174  
(PARTICLE BEAMS, ELECTRON)  
(Generation)

SIMULATIONS OF INTENSE RELATIVISTIC ELECTRON BEAM GENERATION BY  
FOILLESS DIODES

M.E. Jones and L.E. Thode  
Los Alamos National Labs, Los Alamos, NM 87545  
2nd IEEE International Pulsed Power Conference Proceedings, pp 68-71  
(06/1979)

Foilless diodes used to produce intense annular relativistic electron beams have been simulated using the time-dependent, two-dimensional particle-in-cell code CCUBE. Current densities exceeding 200 kA/sq.cm. have been obtained in the simulations of a 5 MeV, 35 ohm diode. Many applications, including microwave generation, collective ion acceleration and high-density plasma heating require a laminar electron flow in the beams. The simulation results indicate that foilless diodes immersed in a strong external magnetic field can achieve such a flow. Diodes using technologically achievable magnetic field strengths (approximately 100 kG) and proper electrode shaping appear to be able to produce beams with an angular scatter of less than 35 mrad at the current densities and energies mentioned above. Scaling of the impedance and temperature of the beam as a function of geometry, magnetic field strengths and voltage is presented. 11 Refs.

Primary Keywords: Annular E-beam; High Impedance; Laminar Flow; Good Collimation; Numerical Calculation  
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7175  
(ENERGY STORAGE, MECHANICAL; PULSE GENERATORS)

Rotating Machines: Rotating Machines: CONSIDERATIONS FOR COMPENSATED  
FUNDAMENTAL LIMITATIONS AND DESIGN OF PULSED ALTERNATORS

M.F. Maldon, M.L. Bird, M.D. Driga, K.M. Tok, H.G. Rylander and H.H. Woodson  
University of Texas at Austin, Austin, TX 78712  
2nd IEEE International Pulsed Power Conference Proceedings, pp 76-82  
(06/1979)

Since the beginning of a project intended to demonstrate the feasibility of using a compensated pulsed alternator (compulsator) as a power supply for MVA and other solid state laser systems, a great deal of interest has been generated in applying this type of machine to supply energy for other types of loads. This paper outlines the fundamental limitations imposed on the design of such a machine by the mechanical, thermal, magnetic, and electrical properties of the materials used. Using these limitations, the power and energy available from the machine are calculated as functions of machine dimensions. Several configurations for the machine and their relative merits for various applications are also discussed. 5 Refs.

Primary Keywords: Compulsator; Limitations; Pulse Transformer; Load Coupling; Pulse Width Determination  
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7176  
(ENERGY CONVERSION, ELECTRICAL)

(Charging Circuits)  
COMMAND CHARGE USING SATURABLE INDUCTORS

S. Black and T.R. Burkes  
Texas Tech University, Lubbock, TX 79409  
2nd IEEE International Pulsed Power Conference Proceedings, pp 102-105  
(06/1979)

Line-type pulsers operating at repeat rates greater than a few kilohertz require special circuits to insure proper operation of the switch. Specifically, thyristors and other closing switches require a 'grace period' of several microseconds or more before anode voltage is reapplied; this delay allows recovery and prevents reclosure of the thyristor. One method of achieving the required delay time is by using a slightly mismatched PFN and slower-than-resonant charging. However, repetition rates of line-type modulators are limited by the characteristics of resonant charging. In order to increase repetition rates, these characteristics may be modified by using a saturable reactor as a charging inductor. This paper describes design considerations and laboratory performance of saturable inductors used to resonantly charge an energy storage network up to 25 kV with a delay as much as 16.5 microseconds. 1 Ref.

Primary Keywords: Saturable Reactor; Charging Inductor; Line-type Pulsers; Repetition; Thyristor  
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7177  
(BREAKDOWN STUDIES)

(Surface Flashover)  
INVESTIGATIONS OF FAST INSULATOR SURFACE FLASHOVER

J.E. Thompson (1), J. Lin (1), K. Mikkelsen (2) and M. Kristiansen (2)  
(1) University of South Carolina, Columbia, SC  
(2) Texas Tech University, Lubbock, TX 79409  
2nd IEEE International Pulsed Power Conference Proceedings, pp 106-111  
(06/1979)

Electric optical measurements of the electric fields along insulator surfaces have been made to determine the mechanisms associated with fast insulator flashover. Data will be presented that show the temporal and spatial performance of the surface fields prior to and at flashover for insulator surfaces oriented at 0 Deg. and 45 Deg. with respect to the applied field. Results show that the surface field near the cathode is enhanced and the field near the anode is reduced during the excitation. The results further show a temporal reduction in the field non-uniformity as flashover is approached. The field collapse for 45 Deg. surfaces begins at the anode and propagates at 0.85 cm/ns towards the cathode. Mechanisms consistent with these experimental measurements will be postulated. 10 Refs.

Primary Keywords: Electro-optical Measurements; Surface Field Profiles; Temporal Field Profiles; Field Collapse  
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7178  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)

(Gas, Electrical; Gas Gaps, Switch)  
BREAKDOWN IN SMALL, FLOWING GAS SPARK GAPS

N.K. Cary Jr., D.D. Lindberg and J.W. Rice  
Naval Surface Weapons Center, Dahlgren, VA 22448  
2nd IEEE International Pulsed Power Conference Proceedings, pp 114-118  
(06/1979)

An improved method for studying electrical breakdown in small, flowing gas spark gaps is described. The apparatus and data processing yield the time to breakdown, current, resistance, power dissipation and energy loss in the spark gap during the 4 ns in which the current rises from zero to a near constant value. A specially constructed transmission line terminated in a spark gap and instrumented with a B-dot probe and sampling oscilloscope is used to observe the breakdown. The initial charge on the transmission line and the current, obtained by integrating the B-dot signal, provide the information needed to define the spark gap operation in a well characterized coaxial arrangement. With a temporal resolution better than 50 ps, current components with frequencies to 10 GHz could be measured. An electronic circuit held the gap breakdown voltage and the subsequent change in the transmission line to precise, predetermined values. A computer based data reduction system determined the current waveform from data corrected for the frequency response of the signal delay line. Results are given for argon and nitrogen, each at two overvoltages. 5 Refs.

Primary Keywords: Time to Breakdown; Current; Resistance; Power Dissipation; B-dot Probe; Transmission Line Spark Gap  
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7179  
(BREAKDOWN STUDIES)

(Liquid, Electrical)  
ELECTRICAL BREAKDOWN IN WATER IN THE MICROSECOND REGIME

D.B. Fennerson and R.J. Grishover  
Naval Surface Weapons Center, Dahlgren, VA 22448  
2nd IEEE International Pulsed Power Conference Proceedings, pp 122-124  
(06/1979)

This paper describes the research on electrical breakdown in water currently being pursued at NSWC/DL. The experimental apparatus is described in some detail. Results of over 500 tests are presented. Breakdown events were observed predominantly in the 2-10 microsecond time domain for applied electrical fields in the range 200-500 kV/cm. The wide scatter of the breakdown time which is intrinsic to the phenomenon requires a careful examination of the statistics of the data. 2 Refs.

Primary Keywords: High Fields; Water Conditioning; Wide Statistical Variation  
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7180  
(PARTICLE BEAMS, ELECTRON)

(Generation)  
PULSED ELECTRON FIELD EMISSION FROM PREPARED CONDUCTORS

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Physic International Co. San Leandro, CA 94577  
2nd IEEE International Pulsed Power Conference Proceedings, pp 127-132  
(06/1979)

The electron emission characteristics of metal cathodes subjected to pulsed electric fields in the absence of insulating magnetic fields has been investigated experimentally. Uniform electric fields in the range of 0.2-0.8 MV/cm were applied to 50 sq.cm. surfaces under vacuum in single pulses of approximately 60 ns duration at a voltage of approximately 0.5 MV. Bare metals and metals coated with dielectric materials were studied. Results show that bare metal, with freshly prepared surfaces can withstand fields of 25-300 kV/cm for > 40 ns without significant emission. Emission-induced discharges degrade the surfaces such that full space-charge-limited current densities (100-250 A/sq.cm. for this experiment) are obtained at fields as low as 200 kV/cm on subsequent pulses. In the case of coated surfaces, it was found that dielectrics could occasionally suppress emission completely up to approximately 300-400 kV/cm, and under some conditions could partially suppress emission after having permitted significant current at fields up to 2.6 MV/cm. 12 Refs.

Primary Keywords: Metal Cathode; High Fields; No Magnetic Field; Discharge  
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7181  
(BREAKDOWN STUDIES)

(Lightning)  
INVESTIGATION INTO TRIGGERING LIGHTNING WITH A PULSED LASER

C.W. Schubert Jr. and J.R. Lippert  
USAF Research Dynamics Lab, Atmospheric Electricity Hazards Group  
2nd IEEE International Pulsed Power Conference Proceedings, pp 132-135  
(06/1979)

Theoretical and experimental considerations for the triggering of lightning with a high-power pulsed laser are discussed. The mechanisms of laser-induced clean air breakdown, aerosol breakdown, and channel heating over a long path for the purpose of initiating and possibly guiding lightning are reviewed. It is shown that long path (of the order of one kilometer) ionization through laser-induced clean air breakdown is theoretically possible. Channel heating over a long path appears possible, but requires prohibitive energies. Indications are that long path ionization can be enhanced by taking advantage of the significantly reduced power requirements for aerosol breakdown. The Mt. Baldy, New Mexico, experimental test site for 1978-1979 experiments and triggering attempts is briefly described. 6 Refs.

Primary Keywords: Clean Air Breakdown; Aerosol Breakdown; Channel Heating; Long Path; Theory; Experiment  
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7182

(SYSTEMS)

(U)

## ANALYSIS OF A DISTRIBUTED PULSE POWER SYSTEM USING A CIRCUIT ANALYSIS CODE

L.O. Hoeft

BDM Corp., Albuquerque, NM 87136

2nd IEEE International Pulsed Power Conference Proceedings, pp 149-152 (06/1979)

A sophisticated computer code (SCEPTRE), used to analyze electronic circuits, was used to evaluate the performance of a large flash X-ray machine. This device was considered to be a transmission line whose impedance varied with position. This distributed system was modeled by lumped parameter sections with time constants of 1 ns. The model was used to interpret voltage, current, and radiation measurements in terms of diode performance. The effects of tube impedance, diode model, switch behavior, and potential geometric modifications were determined. The principal conclusions were that, since radiation output depends strongly on voltage, diode impedance was much more important than the other parameters, and the charge voltage must be accurately known. 3 Refs.

Primary Keywords: Flash X-ray Machine; Numerical Calculation; Modelling; Transmission Line; Gas Insulation; Impedance; Switching

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7183

(DIAGNOSTICS AND INSTRUMENTATION)

(Voltage)

## DETERMINATION OF LINE VOLTAGE IN SELF-MAGNETICALLY INSULATED FLOWS

C.W. Model Jr., J.P. Vandevender and G.W. Kushe

Sandia Labs, Albuquerque, NM 87115

2nd IEEE International Pulsed Power Conference Proceedings, pp 153-156 (06/1979)

Resistive and capacitive voltage monitors for self-magnetically insulated lines have been found to be unsatisfactory. However, it is known that the boundary current  $I_{\text{sub B}}$  and total current  $I_{\text{sub T}}$  are related to line voltage  $V$  and the total and boundary current can be used to infer the voltage. In this presentation we show relationships between  $V$ ,  $I_{\text{sub T}}$  and  $I_{\text{sub B}}$  which are fairly insensitive to the canonical momentum distribution of flowing electrons. Using these relations we conclude that the voltage can be calculated from  $I_{\text{sub T}}$  and  $I_{\text{sub B}}$  with moderate accuracy with no knowledge about the particular flow involved, and quite accurately if only two experimentally determined parameters are known. The inferred voltage waveforms will be compared to experimental voltage data. 7 Refs.

Primary Keywords: Voltage Measurement; Boundary Current; Total Current; Canonical Momentum

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7184

(ELECTROMAGNETIC FIELD GENERATION)

(Magnetic)

## THE DESIGN OF SOLENOIDS FOR GENERATING HIGH MAGNETIC FIELDS

P. Bystrzanski

Institute Of Physics, Polish Academy Of Sciences, Warsaw, Poland

2nd IEEE International Pulsed Power Conference Proceedings, pp 148 (06/1979)

Magnetic fields of high intensity are usually generated by the pulsed discharge of capacitor banks through solenoids. In order to generate the highest fields, exploding coils or field compression techniques are used. However, for experiments it is essential that the coil withstand the electrodynamic forces. This is achieved by employing coils in which the stress exerted by the current density and the magnetic field does not exceed the strength of the material used to build the coil. 0 Refs.

Primary Keywords: Field Compression; Mechanical Forces; Current Density

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7185

(ENERGY STORAGE, CAPACITIVE)

(Systems)

## VERSATILE HIGH ENERGY CAPACITOR DISCHARGE SYSTEM

V.N. Martin

GTE Labs Inc., Waltham, MA 02154

2nd IEEE International Pulsed Power Conference Proceedings, pp 157-160 (06/1979)

The requirements for generating high current pulses of various amplitudes over a range of 10 kA to 100 kA and 10 V to 100 V are being met through the development of a compact, critically damped LCR discharge system capable of 0.75 microsecond rise time and 100-1000 J of energy. The system comprises a vacuum capacitor bank, electrically isolated SCR switch, and a load inductor. The capacitor bank is capacitively matched to a nominal value of 500 pF, which is controlled by a multielement SCR switch and can be discharged through inductor and resistors to provide energy of a 60-cycle sinusoid at peak current values up to 16,000 A. Circuit designs are presented for the isolation and status indication of each of the 500 capacitors, for inverse diodes to protect the polarized capacitors from reverse recovery voltage experiments performed after the main capacitor bank discharge, and for protection of the capacitors from overvoltage conditions. 3 Refs.

Primary Keywords: LCR Discharge System; Sinusoidal Output; Low Frequency; Low Voltage

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7186

(PULSE GENERATORS)

(Line Type)

## A HIGH CURRENT PULSER FOR EXPERIMENT 225, INFILTRING ELECTRON ELASTIC SCATTERING

C. Dalton, G. Krauss and J. Sarrent

Los Alamos National Lab., Los Alamos, NM 87545

2nd IEEE International Pulsed Power Conference Proceedings, pp 232-234 (06/1979)

With the advent of low cost honeycomb extrusions of polypropylene sheath, flash chambers have become very attractive for large nuclear particle detector arrays. This has brought about the need for a pulse power system that will provide high peak currents and low levels of spurious radiation. Each module of 10 flash chambers will require a peak current of 20 kA with a rise time (to 0.7) of 40 ns, giving a maximum rate of current rise of 400 kA/microsecond. The pulser output must deliver 40 ns as a load of 0.16 ohm with a pulse width of 400 ns. The repetition rate will be 100 per second. This paper describes the development of such a system and the impact of the physical limitations of present commercial technology on system pulse fidelity. 4 Refs.

Primary Keywords: Pulse Generator; Very Fast Rise; Repetition; High Pulse Fidelity

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7187

(SWITCHES, CLOSING; BREAKDOWN STUDIES)

(Liquid Gaps; Self; Liquid; Electrical)

## A STREAMER MODEL FOR HIGH VOLTAGE WATER SWITCHES

F.J. Szazena and V.L. Kenyon III

Naval Surface Weapons Center, Silver Spring, MD 20910

2nd IEEE International Pulsed Power Conference Proceedings, pp 187-190 (06/1979)

An electrical switch model for high voltage water switches has been developed which predicts streamer-switching effects that correlate well with water-switch data from recent Aurora/AMP experiments. Preclosure 'rounding' and postclosure resistive damping of pulseforming line voltage waveforms are explained in terms of spatially-extensive capacitive coupling of the conducting streamers as they propagate across the gap and in terms of time-dependent streamer resistance and inductance. The arc resistance of the Casino water switch end of a gas switch under test on Casino was determined by computer fit to be 0.510 1 ohms and 0.340 06 ohms respectively, during the time of peak current in the power pulse. Energy lost in the water switch during the first pulse is 18% of that stored in the pulseforming line while similar energy lost in the gas switch is 11%. The model is described, computer transient analyses are compared with observed water and gas switch data and the results - switch resistance, inductance and energy loss during the primary power pulse are presented. 3 Refs.

Primary Keywords: Modelling; Preclosure Phenomena; Capacitive Coupling Of Streamers

Secondary Keywords: Aurora; Casino

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7188

(POWER TRANSMISSION)

(Connectors)

## CONTACTS FOR PULSED HIGH CURRENT; DESIGN AND TEST

P. Wildi

University of Texas at Austin, Austin, TX 78712

2nd IEEE International Pulsed Power Conference Proceedings, pp 195-197 (06/1979)

The TEXT Tokamak required the development of a special contact for pulsed high currents for the split coils of the poloidal system at a location which is highly inaccessible. A solution was found in the form of a special plug contact. A prototype was tested to the failure point using the discharge of a homopolar machine. Design, test setup and test results are described and the results are evaluated in view of other uses such as larger contacts and switches. 3 Refs.

Primary Keywords: Plug Contact; Failure Test; High Current; Mechanical Flexibility

Secondary Keywords: TEXT Tokamak

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7189

(PARTICLE BEAMS, ELECTRON)

(Generation)

## DEVELOPMENT OF HIGH CURRENT ELECTRON PULSE ACCELERATORS AT THE INSTITUTE OF HIGH TEMPERATURES

E.A. Abramyan and G.D. Kuleshova

Academy of Sciences of the USSR, Moscow, USSR

2nd IEEE International Pulsed Power Conference Proceedings, pp 202-204 (06/1979)

A short analysis of the problems encountered in the acceleration of long (10-4 sec and longer) pulsed, relativistic electron beams (REB) is given. A description of the parameters of the experimental facilities developed to study these long-pulsed beams is presented, as well. One of the main directions of research on REB conducted at our institute is related to finding ways to create long-pulsed electron beams with currents of the order of 1 kA at an energy of 1 MeV. The program is aimed at studying new energy transfer techniques. 4 Refs.

Primary Keywords: Long Pulse; Relativistic E-beam; Breakdown Time; Collective Ion Acceleration

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7190

(SWITCHES, OPENING)

(Voltage)

## EFFECTS OF A COLLIMATING MEDIUM ON THE PERFORMANCE OF EXPLODING ALUMINUM FOIL FUSES

S.L. Berger

Naval Surface Weapons Center, Dahlgren, VA 22448

2nd IEEE International Pulsed Power Conference Proceedings, pp 237-241 (06/1979)

Exploding foil fuses were exploded electrically by discharging a capacitor bank into a series combination inductance (approximately 50 nH) and fuse. The 2.54 x 2.54 x 0.0025 cm foils were exploded in a sealed chamber. The time to burst and fuse voltage characteristics were investigated as a function of the fuse environment. Results are given for foils exploded in various gases and liquids. 17 Refs.

Primary Keywords: Aluminum Foil Fuse; Voltage Characteristics; Environmental Considerations

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7191

(PARTICLE BEAMS, ELECTRON)

(Generation)

## EMITTANCE MEASUREMENTS ON FIELD EMITTER DIODES

S. Kulke and P. Kihara

Lawrence Livermore Lab., Livermore, CA 94550

2nd IEEE International Pulsed Power Conference Proceedings, pp 209-213 (06/1979)

On the basis of time-integrated emittance measurements, several different types of field emitter diodes were investigated at 1-3 kA, 1 Mbar. The experimental parameters were the cathode type, the anode mesh texture, the diode spacing and voltage, and the level of collimation of the emerging beam. Over a wide range, the emittance was found to be proportional to the level of collimation. With the diode spacing increased, the emittance was found to be essentially independent of the diode voltage and current. The lowest emittances (100-200 microm at 400 A) were obtained with a foil-type cathode in a nonoverlapping configuration. 5 Refs.

Primary Keywords: Field Emission Vacuum Diode; Cathode Type; Anode Mesh; Spacing; Diode Voltage; Collimation

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7215  
(PULSE GENERATORS; ENERGY STORAGE; MECHANICAL)  
(Rotating Machines; Rotating Machines)  
DESIGN OF THE ARMATURE WINDINGS OF A COMPENSATED PULSED ALTERNATOR  
ENGINEERING PROTOTYPE  
J.H. Gully, W.L. Bird, T.M. Bullion, H.G. Rylander, W.F. Woodson and  
H.M. Weldon  
University of Texas at Austin, Austin, TX 78712  
2nd IEEE International Pulsed Power Conference Proceedings, pp 385-391  
(06/1979)  
The design of the armature windings of a 6 kV, 70 kA compensated  
pulsed alternator engineering prototype now under construction at The  
University of Texas at Austin is presented. Electromagnetic forces  
acting on the windings and the resulting mechanical and electrical  
stresses placed on the armature insulation are given. Test results of  
a program to select the ground plane insulation system are described.  
Finally, fabrication methods, tooling, and problems encountered  
during construction are discussed. 7 Refs.  
Primary Keywords: Compensator; Analysis; Insulation System  
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7216  
(BREAKDOWN STUDIES)  
(Electrodes)  
FAST RISING TRANSIENT HEAVY CURRENT J-ARK DAMAGE TO ELECTRODES  
A. Watson  
Texas Tech University, Lubbock, TX 79409  
2nd IEEE International Pulsed Power Conference Proceedings, pp 471-474  
(06/1979)  
Crests of displaced metal have been observed in rings beyond the  
crater produced on electrodes by short duration (10-100 ns) heavy  
current sparks in a variety of dielectric media. Metal is presumed to  
have melted and flowed radially. The hydromagnetic forces supporting  
a standing canal wave which is identified with the crest. Analysis  
shows this situation to be invariant under steady melting and the  
ring diameter is proportional to the square root of spark current as  
measurement verifies. Erosion is proposed to occur by the breaking of  
this crest or by its removal under the action of electrostatic  
forces, in accord with earlier experimental data. 2 Refs.  
Primary Keywords: Electrode Erosion; Displaced Metal; Crests  
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7217  
(PULSE GENERATORS; ELECTROMAGNETIC FIELD GENERATION;  
(Flux Compression; Magnetic)  
MAGNET OPTIMIZATION FOR PULSED ENERGY CONVERSION  
W.K. Tucker (1), E.C. Chare (1), W.P. Brooks (1), R.E. Wilcox (2) and  
J.D. Markiewicz (2)  
(1) Sandia Labs, Albuquerque, NM 87115  
(2) Intermagnetic General, Billerica, MA  
2nd IEEE International Pulsed Power Conference Proceedings, pp 381-384  
(06/1979)  
A flux compression generator called PULSAR is being developed to  
meet power requirements for future fusion reactors. Key components of  
the generator are superconducting magnet, generator coil of normal  
conductor, and an armature, either a metallic conductor or plasma.  
Chemical energy is used to increase the mutual inductance between the  
armature and nested generator coil and superconducting magnet. Flux  
compression occurs and electrical energy is transferred to a load  
inductance. This paper will present the results of a study that was  
conducted to design a suitable superconducting magnet for the PULSAR  
device. 6 Refs.  
Primary Keywords: PULSAR; Flux Compression; Generator; Initial Flux  
Generator; Superconducting Magnet Coil; Direct Load  
Connection  
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7218  
(PULSE GENERATORS)  
(Rotating Machines)  
THE DESIGN, ASSEMBLY, AND TESTING OF A DESK MODEL COMPENSATED PULSED  
ALTERNATOR  
H.A. Pichot, W.L. Bird, M. Brennan, M.D. Driga, J.H. Gully, H.G.  
Rylander, K.M. Toik, W.F. Woodson and H.M. Weldon  
University of Texas at Austin, Austin, TX 78712  
2nd IEEE International Pulsed Power Conference Proceedings, pp 398-401  
(06/1979)  
The Center for Electromechanics (CEM) at The University of Texas  
is currently involved in the design, fabrication, and testing of a  
prototype compensated pulsed alternator (compulsator). This machine,  
a new concept in pulsed power technology, utilizes the principles of  
magnetic induction and flux compression to convert rotational energy  
directly into electrical energy. The subject of this paper is a  
one-fifth scale version of the CEM prototype. This desk model  
compulsator is a portable demonstration machine designed to operate  
in the same fashion as the full scale model. 5 Refs.  
Primary Keywords: Compulsator; Prototype; Design Considerations  
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7219  
(PULSE GENERATORS; ENERGY STORAGE; MECHANICAL)  
(Rotating Machines; Rotating Machines)  
MECHANICAL DESIGN OF A COMPENSATED PULSED ALTERNATOR PROTOTYPE  
M. Brennan, W.L. Bird, J.H. Gully, M.D. Driga, K.M. Toik, W.F. Woodson,  
H.G. Rylander and H.M. Weldon  
University of Texas at Austin, Austin, TX 78712  
2nd IEEE International Pulsed Power Conference Proceedings, pp 392-397  
(06/1979)  
A compensated pulsed alternator (compulsator) is  
presently under construction at the Center for Electromechanics (CEM)  
of the University of Texas at Austin. The unique machine  
configuration and high output current (150 kA) generate large forces  
not typically seen by conventional rotating machines. The rotor is  
made of 2013 aluminum and is fixed on a vertical shaft. Since the  
rotor has a diameter of 2.04 m and a maximum speed of 5400 rpm, these  
rotational dimensions are a major concern on the ends with large Belleville  
washers to increase the effective stiffness. The stator is mounted on a  
rigid frame which allows it to rotate during discharge to reduce the  
forces transmitted to ground. The mechanical considerations and  
design of this machine are presented. 6 Refs.  
Primary Keywords: Compulsator; Mechanical Design; Rotor Design; Stator  
Design  
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7220  
(PULSE GENERATORS)  
(Applications)  
APPLYING A COMPENSATED PULSED ALTERNATOR TO A FLASHLAMP LOAD FOR  
NOVA-PART II  
W.L. Bird, D.J.T. Mayhall, W.F. Woodson, H.G. Rylander and H.M. Woodson  
University of Texas at Austin, Austin, TX 78712  
2nd IEEE International Pulsed Power Conference Proceedings, pp 463-466  
(06/1979)  
The compensated pulsed alternator (compulsator) has been proposed  
as a possible alternative to capacitor banks for driving xenon  
flashlamps for pumping neodymium glass laser amplifiers for NOVA. An  
algorithm for sizing rotor diameter and angular velocity as a  
function of flashlamp impedance, peak current, and delivered energy  
is described. It is shown that the armature inductance variation is a  
major consideration when matching the pulsed alternator to the load.  
Finally, conceptual design parameters of a four pole, laminated rotor  
compulsator are presented. 5 Refs.  
Primary Keywords: Compulsator; Start-up Current; Flashlamp Triggering;  
Impedance Matching  
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7221  
(ELECTROMAGNETIC LAUNCHERS; PULSE GENERATORS)  
(Railguns; Systems)  
A COMPACT 5012 AMP/SEC RAIL-GUN PULSER FOR A LASER PLASMA SHUTTER  
L.P. Bredlow, E.L. Orban and I.F. Stowers  
Lawrence Livermore Lab, Livermore, CA 94550  
2nd IEEE International Pulsed Power Conference Proceedings, pp 467-470  
(06/1979)  
We have developed a rail-gun plasma source to produce a plasma of  
1E21 cm<sup>-3</sup> sup-3/2 particle density and project it with a velocity of  
3.9 cm/microsecond. This device will be used in an output spatial  
filter of Nova to project a critical density plasma across an optical  
beam path and block laser retroreflected light. The object of this  
paper is to describe the design of a pulser appropriate to the Shiva  
laser fusion facility, and to describe the preliminary design of a  
higher current prototype pulser for Nova the laser fusion research  
facility under construction at Lawrence Livermore Laboratory. 3 Refs.  
Primary Keywords: Exploding Wire; Multiple Switches; Low Jitter;  
Triggering; Nonlinear Load Effect  
Secondary Keywords: Shiva (LL); Nova  
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7222  
(ENERGY STORAGE; CAPACITIVE)  
(Mark Generators)  
REVIEW AND STATUS OF ANTARES  
J. Jensen  
Los Alamos National Labs, Los Alamos, NM 87545  
2nd IEEE International Pulsed Power Conference Proceedings, pp 31-41  
(06/1979)  
The laser fusion effort at the Los Alamos Scientific Laboratory  
(LASL) has evolved from early experiments with an  
electron-beam-controlled large-aperture CO/sub 2/ laser to the  
massive engineering task of designing and building a 100-kJ laser  
fusion machine. The design of Antares is based on the design of its  
predecessors. It builds upon technology which was developed or  
advanced during the design and construction of earlier machines. On  
one hand it is dictated by the requirements for the output, i.e.,  
energy on target, on the other hand it is limited by existing  
technology or reasonable extensions thereof. Reliability and  
maintainability play important roles in the design considerations.  
10 Refs.  
Primary Keywords: Gas Laser; Beam Propagation; E-beam Pumping; Mark  
Generators  
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7223  
(REVIEWS AND CONFERENCES)  
(Reviews)  
THE NEAR AND LONG TERM PULSE POWER REQUIREMENT FOR LASER DRIVEN  
INERTIAL CONFINEMENT FUSION  
W.L. Gagnon  
Lawrence Livermore Lab, Livermore, CA 94550  
2nd IEEE International Pulsed Power Conference Proceedings, pp 49-54  
(06/1979)  
Inertial confinement fusion research is being vigorously pursued  
at the Lawrence Livermore Laboratory and at other laboratories  
throughout the world. At the Lawrence Livermore Laboratory, major  
emphasis has been placed upon the development of large, Nd:glass  
laser systems in order to address the basic physics issues associated  
with light driven fusion targets. A parallel program is directed  
toward the development of lasers which exhibit higher efficiencies  
and shorter wavelengths and are thus more suitable as drivers for  
fusion power plants. This paper discusses the pulse power technology  
which has been developed to meet the near and far term needs of the  
laser fusion program at Livermore. 14 Refs.  
Primary Keywords: Laser Pumping; Optical Shutter  
Secondary Keywords: Inertial Confinement  
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7224  
(POWER TRANSMISSION; INSULATION; MAGNETIC)  
(Transmission Lines)  
SELF-MAGNETICALLY INSULATED POWER FLOW  
J.R. Nordbender  
Sandia Labs, Albuquerque, NM 87115  
2nd IEEE International Pulsed Power Conference Proceedings, pp 31-40  
(06/1979)  
Electromagnetic power transfer through self-magnetically  
insulated vacuum transmission lines has been developed into a useful  
and reliable technology. A power density of 1E6 W/cm<sup>2</sup> has been  
transported at approximately 100 percent efficiency over six miles.  
The theoretical understanding of power flow through lines of constant  
cross section has progressed through analytical theory and  
electromagnetic particle simulations. However, work has to be done  
on the effects of line transitions in which the cross section changes  
in the direction of power flow. The major features of our present  
understanding will be reviewed and some promising hypotheses now  
under investigation will be presented. 14 Refs.  
Primary Keywords: High Power Density; Configuration Transmission;  
Convolutions; Cross Sections; Load Impedance  
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7225  
(PARTICLE BEAMS, ELECTRON)  
(General)  
VOLTAGE DISTRIBUTION AND CURRENT IN A CYLINDRICAL RELATIVISTIC DIODE  
N.W. Harris  
Ion Physics Corp., Burlington, MA 01803  
2nd IEEE International Pulsed Power Conference Proceedings, pp 65-67  
(06/1979).  
The voltage distribution and current in a space charge limited cylindrical diode are calculated by means of a simple computer program. Relativistic formulation is used, and the results are applicable up to the limit of significant beam pinch. The accuracy is 0.1%. 3 Refs.  
Primary Keywords: Voltage Distribution; Current; Space Charge Limited.  
Numerical Calculations; High Accuracy  
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7226  
(SWITCHES, OPENING)  
(Mechanical)  
DEVELOPMENT OF A HIGH-POWER VACUUM INTERRUPTER  
J.A. Rich, G.A. Farrel, I. Imam and J.C. Sofianek  
General Electric Co., Schenectady, NY 12301  
EPRI Report No. EPRI EL-1895 (06/1981).  
Availability: EPRI EL-1895

Despite their many advantages and their wide use in distribution systems, vacuum interrupters have been too limited in current and voltage for application on today's transmission systems. The goal of this investigation is to assess the feasibility of designing and building a vacuum interrupter for such applications; to specifically develop a vacuum interrupter with a voltage capability in the 2-80 kV range and a current capability in the 63-80 A range with a continuous current rating of 1000 A. To implement this undertaking, analytical and experimental work was carried out in four major problem areas: arc physics; vacuum breakdown; mechanical problems; interrupter fabrication and test. The leading concept is that of the diffuse vacuum arc, particularly as embodied in electrode structures of rod array type, structures which are capable of carrying very large arcing currents without suffering damage. Corollary to the diffuse arc concept is that of arc transfer from the butt contacts to the fixed rod diffuse arc structure and the separation of functions which this allows. 8 Refs.  
Primary Keywords: Vacuum Interrupter; Circuit Breaker; High Voltage; High Current; Vacuum Arc Physics  
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7228  
(SWITCHES, OPENING; SWITCHES, OPENING)  
(Vacuum Gaps; Self-Excited; Magnetic Field)  
DEVELOPMENT OF A VACUUM ARC FAULT CURRENT LIMITER  
R. Dollinger and A.S. Gurnour Jr.  
State University of New York at Buffalo, Buffalo, NY 14226  
EPRI Report No. EPRI EL-1947 (07/1981).  
Availability: EPRI EL-1947

The primary purpose of this program was to develop an understanding of the operating principles of the vacuum arc devices under development at the State University of New York at Buffalo for fault current limiting applications. The general operating characteristics are given for two basic vacuum arc devices. One is the Vacuum Arc Fault Current Limiter and the other is the Magnetically Controlled Vacuum Arc Switch. The results of detailed studies of the phenomena occurring with the two devices are described. In particular, the repetitive voltage spiking phenomenon that occurs in the vacuum arc fault current limiter is treated in substantial detail. The mechanism of the voltage spiking (the repetitive formation and collapse of an anode sheath) is described along with measurements that were made of parameters associated with repetitive spiking. Techniques for enhancing current limiting by enhancing spiking development are discussed. Work on the magnetically controlled vacuum arc switch and the cooperative efforts with the industrial partner (Gould-Brown Boveri) are described. 17 Refs.  
Primary Keywords: Current Limiter; Vacuum Interrupter; Vacuum Spark Gap; Magnetic Control; Fault Current; Characteristic  
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7230  
(POWER TRANSMISSION; DIAGNOSTICS AND INSPECTION)  
(Transmission Lines)  
FEASIBILITY STUDY: THE USE OF AN ENVIRONMENTAL CHAMBER FOR THE EXAMINATION OF TRANSMISSION LINE ELECTRIC FIELD AND CORONA EFFECTS  
S.A. Sebo, R.W. Dwyer and G.G. Raithe  
Ohio State University, Columbus, OH  
EPRI Report No. EPRI EL-1955 (07/1981).  
Availability: EPRI EL-1955

The recent investigation of the feasibility of an environmental chamber combined with model-scale and full-scale (with reduced spacing) conductors for the examination of transmission line electric field and corona effects. The feasibility of tests in a full-scale environmental chamber related to ground level electric field strength, corona starting voltage, conductor surface conditions, corona mechanisms, corona losses, ozone emission, audible noise, radio noise, and DC corona phenomena for changes in energizing voltages, geometry, conductor types and materials, and atmospheric conditions are reviewed. Environmental chamber design considerations and preliminary specifications are also outlined with a review of supply requirements and guidelines for instrumentation. The reduction of this report is positive. The use of an environmental chamber is indicated with model-scale and full-scale (with reduced spacing) conductors for the examination of transmission line electric field and corona effects is feasible and meaningful. Such a specialized purpose environmental chamber is not a replacement of full-scale test, present or future, but it serves a development and design. The performance of the chamber is comparable to that of a high-voltage outdoor test. However, the scope of experiments in the chamber is much greater than in an outdoor test case. 23 Refs.  
Primary Keywords: Transmission Line; Corona; Atmospheric Pressure; Test Chamber; Design Considerations  
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7231  
(BREAKDOWN STUDIES; INSULATION, MATERIAL)  
(Solid; Electrical; Solid)  
INVESTIGATION OF MECHANISM OF BREAKDOWN IN XLPE CABLES  
A.L. McKee, H.C. Dooker, K. Tsuji and A. Zidon  
Phelps Dodge Cable and Wire Co., Tonawanda, NY 14202  
EPRI Report No. EPRI-1D-138 (07/1976).  
Availability: EPRI-1D-138

EPRI  
This research program explores the basic hypothesis that microporosity plays a significant role in the mechanism of breakdown of XLPE cable. In Part I, the potential improvement achieved by impregnating the microporous regions of the cable core with a neutral liquid is evaluated, with relation to AC voltage life and impulse strength. The effect at higher frequency is also demonstrated. In Part II, a similar test program is pursued on model cables, designed to explore the effects of gas-pressure and gas type on breakdown and life, since it is reasonable to expect that only the microporous regions of the insulation should be sensitive to the gas-pressure environment. 26 Refs.  
Primary Keywords: Electric Cable; Crosslinked Polyethylene Insulation; Dielectric Breakdown; Microporosity; High Frequency; Impulse Voltage  
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7234  
(SWITCHES, OPENING; BREAKDOWN STUDIES; BREAKDOWN STUDIES)  
(Mechanical; Gas; Electrical; Vacuum; Electrical)  
MODELING OF ARC DISCHARGES IN POWER CIRCUIT BREAKERS  
I.K. Cohen and A.M. Whelan  
University of Pennsylvania, Philadelphia, PA 19104  
EPRI Report No. EPRI EL-457 (11/1977).  
Availability: EPRI EL-457

EPRI  
The question that this model attempts to answer is: 'What effect does electrode geometry have on an electric arc?' This problem is attacked in a quantitative way in terms of the curvature of the electrodes. The next question is whether, after a given interruption attempt, the fault will be cleared. A new type of mathematical attack on this problem was initiated in the model, and it shows that an understanding of the problem can be obtained in a rigorous and physically meaningful way. The analysis is based on the stability of the mathematical model. The results show how much any interruption depends on arc characteristics and circuit parameters. Real power circuit breakers are influenced by convection and radiation, which are mechanisms for energy dissipation. In order to make the model more realistic, it has been extended to incorporate these effects. Previous experience with the simpler models has given an insight as to how to deal with these complications. 282 Refs.  
Primary Keywords: Circuit Breaker; Arc Modeling; Electrode Geometry  
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7237  
(INSULATION, MATERIAL)  
(Composite)  
SF/SUB 67 FOAMED INSULATION  
E.G. Greshner  
Gulf, Inc., Calmar, PA 18915  
EPRI Report No. EPRI-520 (08/1977).  
Availability: EPRI EL-520

EPRI  
This study describes sulfur hexafluoride (SF/sub 67) epoxy foam, a novel material which consists of a highly electronegative gas (SF/sub 67) confined in a network of closed epoxy cells. SF/sub 67 epoxy foam can be prepared by mixing liquid epoxy and molecular sieves that have been highly loaded with SF/sub 67 molecular sieves adsorb approximately 25% by weight SF/sub 67. When the mix is heated, the molecular sieves release their adsorbed SF/sub 67, thus forming the foam. The foamed cells of the SF/sub 67 foam are small, evenly distributed and indicate this unique material is suitable for high voltage electrical insulation. These properties include a low dielectric constant, a high dielectric strength, the ability to maintain dielectric strength when punctured by a low power source), and a high dielectric strength. 6 Refs.  
Primary Keywords: SF/sub 67 Epoxy Foam; Low Dielectric Constant; Insulation; Dielectric Strength  
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7238  
(BREAKDOWN STUDIES)  
(Gas; Electrical)  
SUPERPOSITION GAS BREAKDOWN  
J.K. Dole  
Westinghouse Research and Development Center, Pittsburgh PA  
EPRI Report No. EPRI EL-1484 (08/1980).  
Availability: EPRI EL-1484

EPRI  
Results are described of a research program investigating breakdown in a 76250 mm coaxial electrode system in compressed SF/sub 67 as a result of superposition of impulse voltages on the 60 Hz power frequency voltage. The presence of conducting particles. The object of this program is to experimentally determine if impulse superposition is a more severe condition for particle initiated breakdown than the 60 Hz voltage alone, which can result in breakdown as low as only ten percent of the dielectric strength of SF/sub 67. Breakdown voltages were measured for particles both isolated and in contact with the center conductor, and also for multiple free cloud of particles in the system for impulse voltages, 60 Hz voltage and with impulses superposed on the 60 Hz voltage. The results showed that the lowest values obtained with the superposition of impulse voltages on the 60 Hz voltage were equal to the lowest values of the 60 Hz or impulse voltages alone. The probability for particle initiated breakdown as a result of superposed impulse voltage with realistic magnitudes of the 60 Hz voltage was found to be negligible and was entirely dominated by the 60 Hz breakdown probability. 13 Refs.  
Primary Keywords: SF/sub 67 Gas; Coaxial Electrodes; Power Line Frequency Voltage; Impulse Voltage; Superposition; Particulate Suspension; Transmission Line  
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7240

(PULSE GENERATORS)  
(Hard-tube)

A MODULATOR FOR THE SEASAT-A RADAR ALTIMETER

K.Y. Ishikawa, C.T. McCown and G.E. Stronks

Hughes Aircraft Co., Torrance, CA 90509

1978 IEEE Thirteenth Modulator Symposium, pp 235-241 (06/1978).

This paper describes the modulator for the Seasat-A Radar Altimeter. The unit, which consists of a grid modulator, power supply and traveling wave tube (TWT), has been delivered to the Applied Physics Laboratory for their altimeter system in the Seasat-A Global Weather and Ocean Survey satellite. The TWT power supply develops 12 kilowatts at an average power of 70 watts and peak power of 18 kilowatts during pulse operation. The grid modulator which operates at the TWT cathode potential swings the grid voltage over a 350 volt range with rise and fall times of less than 80 nanoseconds to gate the TWT RF signal on and off. Transition times of approximately 13 nanoseconds are realized for the RF output pulse. During the pulse operation the cathode voltage is held to within 2 volts by the wide bandwidth cathode voltage regulator. 1 Refs.

Primary Keywords: Grid Modulator; Fast Rise; Fast Fall; Low Voltage; Transistor Switch

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7241

(ENERGY CONVERSION, ELECTRICAL)

(Power Supplies)

A STABLE LOAD-INVARIANT HIGH-FREQUENCY SCR SERIES RESONANT INVERTER FOR

RADAR TRANSMITTER APPLICATIONS

R.C. Cole

ITT, Watley, NJ

1978 IEEE Thirteenth Modulator Symposium, pp 14 (06/1978).

A high-frequency series resonant SCR inverter has been developed for radar transmitter power conversion and regulation applications that overcomes most of the limitations of present-day high-frequency SCR inverters. Significant characteristics of the inverter circuit include stable operation and controlled resonant capacitor voltages over a wide range of input line voltages and load resistances (including short-circuit loads), fast response, and high efficiency. Low internal stored energy permits automatic reset of faults without destructive failure or reliance on fusing. The inverter is ideally suited for charging or capacitor loads typical of radar transmitter and other pulsed discharge applications. An experimental inverter, operating from 208-V 3-phase ac, provides 30-kW output into a load resistor connected to the inverter through a bridge rectifier and energy storage capacitor. The inverter switching frequency is 10 kHz. Reliable operation with complete freedom from commutation failures has been demonstrated using non-preset SCR's. Predicted control of inverter resonant capacitor voltages has been shown for all loads, including a short circuit. Two such units can be paralleled to develop a 60-kV 60-kW regulated high-voltage power supply for a radar transmitter. 0 Refs.

Primary Keywords: Stable Operation; Short Circuit Load; Small

Internally Stored Energy

Secondary Keywords: Abstract Only

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7242

(SWITCHES, CLOSING; SWITCHES, OPENING)

(Vacuum Tubes; Vacuum Tubes)

A 100 KV, 80 AMP, LONG PULSE SWITCH TUBE

S.G. McNeas

Varian EIMAC Div., San Carlos, CA 94070

1978 IEEE Thirteenth Modulator Symposium, pp 180-182 (06/1978).

A high power vacuum grid tube has several characteristics which make it ideally suited for repeated DC high voltage, high current, interrupt applications. It has no moving parts, no arc quenching problems, adjustable current limiting in the case of a shorted load, and the ability to dissipate power. This latter feature can be used to advantage to pre-program any desired divert during the turn 'on' or turn 'off' interval. The ability to handle large amounts of dissipation during the turn 'off' cycle permits the high vacuum power grid device to be used as a voltage regulator, a very attractive feature for constant voltage regulation in neutral beam sources. The power grid tubes described here have 150 kV and 80 Amps. DC ratings and typically operate at 97 to 98 percent efficiency. They require approximately 25 kW of auxiliary power for filament and driver circuits. 0 Refs.

Primary Keywords: Vacuum Grid Tube; DC Current Interruption;

Adjustable Current Limiting; High Efficiency

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7243

(PULSE GENERATORS)

(Pulse Forming Lines)

DRIVING POKKEL'S CELLS IN MULTI-ARM LASERS

B.M. Gorder

Lawrence Livermore Lab., Livermore, CA 94550

1978 IEEE Thirteenth Modulator Symposium, pp 5-8 (06/1978).

This paper describes the method used to drive Pokkels cells on the 20-arm Shiva laser for inertial confinement fusion research at the Lawrence Livermore Laboratory. Shiva became operational last fall, and has just completed a series of 20-arm target shots. It uses two Pokkels cell gates in each laser arm for suppression of amplified spontaneous emission (ASE) that can damage or destroy the target before the main pulse arrives. Two additional Pokkels cells are used in the pre-amplification stages, so that a total of 42 cells must be driven by the pulser system. 1 Refs.

Primary Keywords: Transmission Line Pulsers; Spark Gap Switch; Variable Load

Secondary Keywords: Vacuum Cell Driver

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7244

(DIAGNOSTICS AND INSTRUMENTATION)

(Data Transmission)

ELECTRO-OPTIC TRANSDUCERS AND OPTICAL FIBERS IN HIGH VOLTAGE MICROWAVE

MODULATORS

P. Cervone and G. Scarf

Selenia SPA, Rome, Italy

1978 IEEE Thirteenth Modulator Symposium, pp 75-78 (06/1978).

This paper describes a new solution for the transfer of information through different voltage levels in a high voltage modulator for gridded microwave tubes. The new solution is realized with the use of electro-optic transducers coupled by optic fibers. A description of the transmission channel, the control unit and the failure and detection is presented. 2 Refs.

Primary Keywords: Data Transmission; Fiber Optic Links; Real Time

Processing; Fast Response

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7245

(POWER CONDITIONING)

(Current Limiters)

ENERGY CONSIDERATIONS IN THE PULSED OPERATION OF A VACUUM ARC CURRENT

LIMITER

C.D. Poulsen, A.S. Gilmour Jr., R. Dollinger and D.P. Malone

State University of New York at Buffalo, Buffalo, NY 14226

1978 IEEE Thirteenth Modulator Symposium, pp 213-216 (06/1978).

It has been demonstrated at SUNYAB that current peaks as high as approximately 120 kA can be limited to approximately 1 kA using a vacuum arc current limiter (VACL). During current limiting a large voltage is developed across the VACL and so a very large impulse of energy is applied to the anode. This paper describes the results of a study that has calculated the current amplitudes with and without the VACL in the system. The resulting energy impulses applied to the device were determined and a transient analysis of the temperature distribution within the anode was made. 4 Refs.

Primary Keywords: Current Limiters; Magnetic Field; High Limiter

Voltage; Anode Temperature Distribution

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7246

(PULSE GENERATORS)

(Line Type)

HAYSTACK HILL LONG-RANGE IMAGING RADAR TRANSMITTER

W. North

GTE Sylvania, Inc., Needham Heights, MA 02194

1978 IEEE Thirteenth Modulator Symposium, pp 247-253 (06/1978).

The Long-Range Imaging Radar (LRIR), developed by MIT Lincoln Laboratory for the USARF, is presently installed at the Haystack Hill NEOPD radio telescope facility in Westford Mass., and uses its 120-foot diameter parabolic reflector antenna. Its transmitter is designed around the Varian VTX-5681 TWT, which was developed specifically for this application under the sponsorship of MIT Lincoln Laboratory. The beam voltage is 42 kVdc at 10 amperes, which is gated by means of the output of a direct-coupled floating deck modulator connected to the unity-gain modulating anode of each parallel-connected TWT. The modulator, which uses Eimac 8960 diode tubes, is capable of pulse durations of from less than 10 microseconds to CW, and PRF's up to 2000/second. Output amplitude control is accomplished by a direct-coupled grid-cathode circuit applied to the upper cathode grid. Low-level signal coupling is by means of a balanced, capacitively-coupled 10 MHz link, using microcircuit components. Maximum use was made of the existing 58 kVdc, 21 ampere HVPS and the 80 kV, 156 mF capacitor bank and crowbar. It was necessary, however, to augment them with a 20-ampere electron to current regulator, between rectifiers and capacitor bank, and a 40-ampere electronic voltage regulator, between capacitor bank and TWT beam input, and an output buffer capacitor bank and separate crowbar. Both regulators use Eimac 40W250,000 tetrodes. 0 Refs.

Primary Keywords: Floating-Deck Modulator; High Average Power;

Conduction Descriptions

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7247

(ENERGY CONVERSION, ELECTRICAL)

(Power Supplies)

HIGH VOLTAGE DC POWER CONDITIONER

D.L. Pruitt

RCA Corp., Moorestown, NJ 08057

1978 IEEE Thirteenth Modulator Symposium, pp 15-21 (06/1978).

Modern radar systems, particularly mobile systems, require high quality, compact, lightweight DC power sources. High frequency (e.g., 10 kHz) power conditioners have been used to obtain the desired qualities. By adapting a variation of the series inverter circuit, liberally infused with artificial line type pulse modulator technology, an effective, simple, and high performance technique has been developed. Low frequency (50 to 400 Hz) transformers are eliminated by direct full wave rectification of the AC power source. With appropriate input filter design, power source frequencies from 50 to 400 Hz can be accommodated in one design. A pair of suitable high frequency thyristors alternately charge and discharge a pair of capacitors through the primary of a pulse power transformer. Since the operating frequency is 1 kHz (thousands of hertz), the transformer and load filter reactor are small compared to the equivalent network power frequency components. Operating Q is low (approximately 1.0) limiting the reactive power. Regulation of the output voltage is achieved by varying the pulse recurrence frequency from as low as 200 Hz to a maximum of 20 kHz. No load to full load regulation, 1.2% has been demonstrated. The circuit is not harmed by overload, and has a current fold-back feature. Normal operation resumes automatically when an overload is removed. 1 Refs.

Primary Keywords: DC Power Supply; Light Weight; High Frequency

Current Descriptions

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7248

(SWITCHES, CLOSING)

(Hybrid Solid State)

HYBRID SCR SWITCH

D.L. Pruitt

RCA Corp., Moorestown, NJ 08057

1978 IEEE Thirteenth Modulator Symposium, pp 157-162 (06/1978).

Hybrid solid state switches are designed and constructed using SCR (silicon controlled rectifier) chips on a beryllia substrate. Peak pulse currents of up to 6000 A with 2 microsecond rise time, or up to 3000 A with 1 microsecond rise time, were achieved. A series stack was constructed to produce a 10 kV air cooled switch. 4 Refs.

Primary Keywords: SCR Networks; High Current; Slow Rise

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7249

(SWITCHES, CLOSING; SWITCHES, OPENING)

(Vacuum Tubes; Vacuum Tubes)

LONG PULSE HIGH EFFICIENCY SWITCH TUBE DEVELOPMENT

A.T. Moreau III

USAF, Griffiss AFB, NY 13440

1978 IEEE Thirteenth Modulator Symposium, pp 183-188 (06/1978).

A high power linear beam tetrode switch tube was tested and evaluated at AFOSR's High Power Laboratory. Utilizing the device as a series modulator for a klystron amplifier, parameters attained were 120 kV beam output at 0.65 duty cycle with pulse lengths up to 300 microseconds. Measurements of efficiency, collector depression, penumbra, control grid interference, anode (screen grid) current and cathode fall dissipation were performed. The ability to control the pulse width and shape was demonstrated at a variety of voltage and pulse levels. These results indicated that operation at 140 kV, 100 amperes at 0.65 duty could be achieved with an appropriate load. This switch tube was designed and fabricated by Varian Associates under AFOSR sponsorship. Details of the advantages of this device for waveform's preliminary testing are covered, in addition to a brief external evaluation. 2 Refs.

Primary Keywords: Linear Beam Tetrode; Series Modulator; Pulse

Control; High Efficiency

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7250  
(SWITCHES, CLOSING; SWITCHES, OPENING)  
(Vacuum Gaps, Electrical; Vacuum Gaps, Magnetic Field)  
MAGNETIC FLUX CONCENTRATION WITH THE ANODE IN A VACUUM ARC SWITCH  
Y. Suen and A.S. Gilmour Jr.  
State University of New York at Buffalo, Buffalo, NY 14226  
1978 IEEE Thirteenth Modulator Symposium, pp 208-212 (06/1978).  
The anode of a vacuum arc switch may be used as a magnetic flux concentrator. This is done to permit the use of a large diameter field coil, perhaps located outside the vacuum envelope, for generating large magnetic flux densities in the anode-cathode interelectrode region. The time required for the magnetic flux to decrease substantially in density because of diffusion through the anode is of interest in switch applications where it is necessary for the arc interruption process to be relatively slow. In this paper measured flux diffusion speeds through a vacuum arc switch anode are compared with those calculated using the diffusion equation subject to boundary conditions in two limiting cases. 2 Refs.  
Primary Keywords: Magnetic Flux Concentrator; Field Diffusion; Anode Processes  
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7251  
(SWITCHES, OPENING; SWITCHES, CLOSING)  
(Vacuum Gaps, Magnetic Field; Vacuum Gaps, Electrical)  
MAGNETICALLY MODULATED VACUUM ARC FOR DC SWITCHING  
R. Dethlefsen and J. Mylius  
Gould Inc., Greensburg, PA 15601  
1978 IEEE Thirteenth Modulator Symposium, pp 227-226 (06/1978).  
Experiments are reported on vacuum arcs in a magnetron-type discharge geometry. Magnetic fields up to 0.6 Tesla are applied. Various degassed cathode materials are tested at currents up to 10 kA. Depending upon geometry, the magnetic field can raise the vacuum arc voltage from typically 150 V to several kV. The probable cause is an electron space charge current limitation in front of the ring shaped anode. Dependent upon parallel capacitance, strong oscillations are excited by the magnetic field. Application of the magnetic field can reduce the arc current from several kA to the current chopping level, where circuit interruption is followed by rapid dielectric recovery. High repetition rates in the kHz region appear feasible. 4 Refs.  
Primary Keywords: Magnetron-type Discharge; Magnetic Modulators; Low Field; Self-generated Field  
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7252  
(PULSE GENERATORS)  
(Hard-tube)  
PEAK SWITCH CURRENT ENHANCEMENT FILTER  
J.P. O'Loughlin (1) and W.H. Mooney (2)  
(1) AFNL, Kirtland AFB, NM 87117  
(2) Tetra Corp, Albuquerque, NM  
1978 IEEE Thirteenth Modulator Symposium, pp 52-54 (06/1978).  
One method of providing ionization in a controlled gaseous discharge is to apply very short over voltage pulses. The voltage is typically several times the breakdown voltage of the gas but the time duration is less than the arc formation time so a complete breakdown does not occur but the gas is ionized. The level of ionization achieved depends on the total charge or equivalently the peak current delivered during the over voltage pulse. Typical parameters used on one experiment were 50 to 100 nanosecond pulses at 35 kV and repetition rates up to 500,000 PPS. A hard tube modulator was designed and built to deliver up to 200 peak amperes. Later in the experiment higher currents were desired and it was found that by using a peak current enhancement filter it was possible to deliver peak current of 350 amperes to the load while the hard tube modulator was only delivering 200 peak amperes. The design and characteristics of such a filter is described in the paper. 3 Refs.  
Primary Keywords: Peak Current Enhancement; 50% Peak Current Increase; Hard Tube Pulsers; Pi Section Filter; Narrow Pulse  
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7253  
(POWER CONDITIONING)  
(Pulse Forming Networks)  
PFN LOSS CALCULATIONS  
S.I. Rambo and R.A. Gardenghi  
Westinghouse Electric Corp, Baltimore, MD 21203  
1978 IEEE Thirteenth Modulator Symposium, pp 43-45 (06/1978).  
Approximation methods for the calculation of PFN losses have been used for many years. With the availability of computer facilities to most electronic engineers today, more precise calculations can be made. Many PFNs designed for thyristor switching have had characteristic impedances high enough that losses could be ignored. However, recent trend to all-solid-state pulsed power requiring very low Z (less than 1 ohm) and high pulse current capability makes it essential that distribution of losses be determined more accurately. This paper describes a proven useful approach, using simplified integrated computer programs. Methods are described for loss calculations by first determining the pulse current shape in each coil and capacitor in the time domain. Then these pulses are transformed into the frequency domain to determine their spectra. By knowing the Q of the coils and the dissipation factor of the capacitors and how they vary with frequency, it is easy to sum the losses for each spectral line for each component. Results agree well with experiments. 0 Refs.  
Primary Keywords: Loss Calculations; Numerical Calculation; Solid State Pulsers; Low Impedance; Comparison With Experiment  
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7255  
(ENERGY CONVERSION, ELECTRICAL)  
(Power Supplies)  
PULSED TWT POWER SUPPLY: A TECHNIQUE FOR MINIMIZING R.F. PHASE INSTABILITY AND HIGH VOLTAGE ENERGY  
F. Tarantino and P. Borsari  
Selenia SPA, Roma, Italy  
1978 IEEE Thirteenth Modulator Symposium, pp 22-26 (06/1978).  
The ripple voltages on the electrodes of the power microwave tube limit the performance of M.T.I. radar system when the radar employs staggered P.P.P. pulse-to-pulse ripple arising due to load duty change. For TWT power amplifier, the variations of the cathode-body voltage cause phase and amplitude modulation of the transmitted wave. It is possible to reduce the cathode voltage variation by increasing the value of the H.V. capacitors. But this solution increases the stored energy increases too. Series regulator is another alternative but this means more sophisticated circuitry with decreasing of reliability and more design efforts. This paper describes a H.V.F.S. configuration which allows to solve the problem with limited H.V. stored energy. 5 Refs.  
Primary Keywords: Detailed Analysis; Voltage Multiplication; Ripple Compensation; Minimum Stored Energy  
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7256  
(SWITCHES, CLOSING)  
(Gas Gaps, Crossed-field)  
THE CROSSED-FIELD CLOSING SWITCH-A STATUS REPORT  
R.J. Harvey (1), R.W. Holly (1), J. Creedon (2) and H. Gauch (2)  
(1) Hughes Research Labs, Malibu, CA 90265  
(2) ECM, Fort Monmouth, NJ 07701  
1978 IEEE Thirteenth Modulator Symposium, pp 79-82 (06/1978).  
The crossed-field closing switch (CFCFS) has been evaluated using a modulator consisting of 25 cables each 15.24 m long. A low-inductance 2-ohm copper sulfate load was used to terminate the modulator in its characteristic impedance. Before evaluating the CFCFS in the cable modulator, studies were made of firing characteristics and mode of operation using a conventional pulse forming network of 0.5 cm impedance matched to a copper sulfate load. The pulse width was a nominal 12 microsecond. Preliminary results were then obtained with the cable modulator at an anode voltage of 23 kV at a peak current of 6 kA and pulse repetition rates up to 500 Hz. The pulse width, measured at the half power points on the load, was 160 ns. Experimental results are shown for the cable modulator test, and the dependence of operating mode on circuit parameters is discussed. 6 Refs.  
Primary Keywords: Performance Test; Rep-rated; Parameter Study  
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7257  
(SWITCHES, OPENING)  
(Mechanical)  
THE USE OF VACUUM INTERRUPTERS AND BYPASS SWITCHES TO CARRY CURRENTS FOR LONG TIMES  
E.M. Hanic and P.W. Warren  
Los Alamos National Labs, Los Alamos, NM 87545  
1978 IEEE Thirteenth Modulator Symposium, pp 194-199 (06/1978).  
Vacuum interrupters are normally designed for use in AC utility circuits where they typically carry a maximum continuous current of 2 kA but must interrupt fault currents well in excess of 25 kA. Vacuum interrupters are also used to carry and interrupt the large DC currents found in fusion devices such as tokamaks. In contrast to AC uses, however, these DC applications usually require that the continuous current limit be the same as the interruptible current limit. In a previous paper we have reported tests performed at the Los Alamos Scientific Laboratory (LASL) which show that the interruption ability of standard vacuum interrupters used with DC currents is satisfactory for currents in excess of 20 kA. Little, however, is known about the ability of standard interrupters to carry such large currents for long times. It is the purpose of this paper to describe measurements which determine the period of time conventional interrupters can carry currents as large as 20 kA without compromising their interruption ability; describe special interrupters which should extend this period; describe a bypass switch we have built and two ways of using it to relieve the vacuum interrupter of its heating load; describe the bypass switch experimental setup and test results; and discuss ways to extend the life of the bypass. 8 Refs.  
Primary Keywords: DC Current Rating; Bypass Switch  
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7258  
(SWITCHES, OPENING)  
(Mechanical)  
THE USE OF VACUUM INTERRUPTERS AT VERY HIGH CURRENTS  
R.W. Warren and E.M. Hanic  
Los Alamos National Labs, Los Alamos, NM 87545  
1978 IEEE Thirteenth Modulator Symposium, pp 189-193 (06/1978).  
There is a slowly growing, widely based need for switches which can be used to interrupt DC currents. In recent years the demands of fusion devices such as tokamaks have overshadowed all others and have illuminated the need for conventional switches with vastly improved performance or for better, entirely new kinds of switches. Switches presently being developed for tokamak uses must interrupt 25 kA at 25 kV with a reliability of 99% or so for a total of many thousands of cycles. Next generation tokamaks may operate at 100 kA and 100 kV and require switches with a reliability of 99.9% and a much longer life. No existing switch can meet these requirements. A promising approach to these goals is based upon a vacuum interrupter used in conjunction with a combination of antipulse capacitor bank. This bank is used to create a forced current zero at which interruption can occur. 10 Refs.  
Primary Keywords: Vacuum Interrupter; DC Current Interruption; Current Commutation; High Reliability; Magnetic Field  
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7260  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
AURORA, AN ELECTRON ACCELERATOR  
B. Bernstein and I. Smith  
Physic International Co, San Leandro, CA 94577  
IEEE Transactions On Nuclear Sciences, Vol. NS-20, No. 3, pp 294-300 (06/1973).  
Aurora was designed to produce a brief, intense radiation pulse, and the electrical specifications derive from the radiation output required. A 'test volume' was defined that was roughly a meter cube. It was desired to irradiate this from one side to an average of 50,000 Roentgens throughout. In the laboratory, such yields can only be obtained as the bremsstrahlung from a high intensity electron beam stopped in a high density 'converter'. To maximize the efficiency of conversion of electron energy into photon energy, the highest possible kinetic energy was selected, consistent with the desire not to produce an excessive quantity of photo-neutrons. The kinetic energy chosen was 15 MeV. Calculations then showed that the dose in the test volume could be achieved with minimum electron energy if the radiation source were a uniformly energized surface about 1.5 m in diameter, placed near one face of the test volume. This source surface is the converter, which must be illuminated by a fairly uniform electron beam. The total charge of 15 MeV electrons needed per pulse was calculated to be about 0.2 C. An electron beam pulse duration of 120 ns was chosen to give the desired radiation pulse duration to allow for the finite rise and fall times of the beam pulse. Thus an electron beam specification of 1.6 MA at 15 MeV was arrived at, giving a peak power of 24 terawatts and a total beam energy of almost 3 MJ per pulse. 2 Refs.  
Primary Keywords: AURORA Accelerator; Design Considerations; Field Emission Diode; Blumlein Line; Marx Generator; System Integration  
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7266  
(PULSE GENERATORS; POWER CONDITIONING; PARTICLE BEAMS, ELECTRON)  
(Mark: Pulse Transformer; Generation)  
COUPLED MARX-TESLA CIRCUIT FOR PRODUCTION OF INTENSE RELATIVISTIC ELECTRON BEAMS

A. Luchas and A. Parrone  
Universita di Lecce, Lecce, Italy  
The Review of Scientific Instruments, Vol. 49, No. 12, pp 1629-1630 (12/1978).

A two-stage Marx circuit was built and is used to multiply the input energy of our Tesla resonant transformer accelerator without missing resonance conditions. The present output characteristics of our coupled Marx-Tesla circuit are compared to those of the previous Tesla transformer. With the same input voltage and cathode to anode distance, we succeeded in doubling output voltage and current of the beam. 4 Refs.

Primary Keywords: E-beam Generation; Marx Generator; Tesla Transformer; 1 MV Accelerating Voltage  
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7268  
DESIGN AND DEVELOPMENT OF A 350 KV, 100 PPS ELECTRON BEAM ACCELERATOR  
S.J. Robinson, M.T. Buttner and K.R. Prestwich  
Sandia Labs, Albuquerque, NM 87115  
No. COM-771035-10, 24p (01/1977)  
Availability: SAND-77-1267C NTIS

A 350 KV, 300 J/pulse, 100 pulses/sec electron beam accelerator was designed and constructed. A description of the physical features of the machine is included along with performance data from the initial operation of the system. (EKA citation 03:010865)

Primary Keywords: Accelerators; Design; Electron Beams; Kev Range 100-1000; Performance; Pulse Circuits; Pulses; Switches; Transformers

Secondary Keywords: ERDA/450100; ERDA/700208; NTISDE

7275  
(ENERGY STORAGE, MECHANICAL)  
(Rotating Machines)  
FUSION APPLICATIONS OF FAST DISCHARGING HOMOPOLAR MACHINES  
K.I. Thomassen  
Los Alamos National Labs, Los Alamos, NM 87545  
EPRI Report No. ER-625 (01/1978)  
Availability: EPRI ER-625

The use of fast discharging homopolar machines, with 1-5000 ms delivery times, are described for toroidal and linear theta pinches, toroidal z-pinches, liners and tokamaks. Typical circuits and machine designs are described. 10 Refs.

Primary Keywords: Fast Discharge; Modeling  
Secondary Keywords: Fusion Driver  
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7276  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
HIGH CURRENT PULSED ELECTRON BEAM GENERATOR  
I. Smith, P. Champney, L. Hatch, K. Nielsen and S. Shone  
Physic International Co, San Leandro, CA 94577  
IEEE Transactions On Nuclear Science, Vol. NS-18, No. 3, pp 491-492 (03/1971)

A review is given of a simple and economical method of generating high current electron beams in the range of a few hundred kilovolts to multi-megavolts at voltages from 100 kV to 1 MV. Mylar dielectric parallel plate transmission lines, switched with either solid dielectric spark gaps or gas spark gaps constitute the pulse forming network. Several such generators have been built that feed a 50 nsec width pulse through a low inductance insulator/vacuum interface to a field emission diode. The electron beam is generated in the diode region and accelerated through a thin window into a drift chamber. One such generator is described in detail. 2 Refs.

Primary Keywords: Field Emission Diode; Drift Tube; Strip Line; Mylar Insulation; Water Encapsulation; Boundary Considerations; Pulse Forming Network  
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7280  
(POWER TRANSMISSION; POWER CONDITIONING)  
(Transmission Lines; Pulse Transformers)  
IMPEDANCE MATCHING BY TAPERED TRANSMISSION LINES

A.W. Gent and P.J. Wallis  
Standard Telephones And Cables, Ltd.  
Proceedings Of The IEE, Vol. 111, Part IIIA, No. 3, pp 559-563 (03/1966)  
Tapered transmission line sections are analyzed in this paper. The standing wave ratio is measured for a tapered line terminated in a coaxial line. It is found that best performance is obtained when the tapered line is equal in length to one half-wavelength. It is also found that the preferred geometry is to taper the inner and outer conductors together. 7 Refs.

Primary Keywords: Tapered Line; Impedance Matching; SWR Measurement; Simultaneous Tapering Of Conductors; Tapered Section Length  
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7284  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Current)  
NANOSECOND RESPONSE 'GASKET-TYPE' MAGNETIC LOOP CURRENT MONITOR FOR RELATIVISTIC ELECTRON BEAM CURRENT MEASUREMENTS  
R.L. Copeland (1), J.L. Adamski (1), W.O. Doggett (2), D.L. Morrow (2) and W.H. Runyon (2)  
(1) Boeing Aerospace Co, Seattle, WA 98124  
(2) North Carolina State University, Raleigh, NC 27607  
The Review of Scientific Instruments, Vol. 50, No. 2, pp 233-235 (02/1979)

A fast response magnetic loop current monitor has been developed to measure relativistic electron beam return currents. The monitor has a rise time of about a nanosecond and a high degree of symmetry with moderate sensitivity, variable from about 1 to 10 V/kA. This simple monitor, with a thickness of 0.254 mm or less, is thin enough to be placed between segments of return current path in the diode or drift tube regions, is insensitive to flashover, burn and plasma bombardment, and radiation effects, and measures net current, thus offering some advantages over conventional magnetic probes, since the main components are outside of the vacuum region. Design criteria, an equivalent circuit analysis, and typical calibration waveforms are presented. Experimental current measurements for a pinched electron beam diode configuration using both conventional magnetic probes and 'gasket-type' current monitors with the FX-75 relativistic electron beam accelerator are presented. 5 Refs.

Primary Keywords: Current Monitor; E-beam Return Current; Return Current Path; Fast Response; 1 ns Rise Time; Environmental Insensitivity; Design Considerations  
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7285  
(BREAKDOWN STUDIES)  
(Surface Flashover)  
NANOSECOND SURFACE DISCHARGE STUDY BY USING DUST FIGURE TECHNIQUES  
Y. Murooka and S. Koyama  
Defense Academy Of Japan, Obanadai, Yokosuka, Japan  
Journal Of Applied Physics, Vol. 44, No. 4, pp 1574-1580 (04/1973)

The developing mechanisms of the positive and negative corona streamers on the insulation surface have been studied by using the dust figure technique together with a line pulser. The present method has the advantage of measuring the velocity of corona discharge development and the discharge mechanism, because the distributions of the positive and negative charges in the discharge figure can be colorfully separated and recorded. By applying shorter time pulses from 10 to 320 nsec duration to a needle point where a glass plate is sandwiched in between the needle and plate electrodes, the diameter of the recorded discharge and the charge quantities and their distributions against the pulse duration were obtained. The observed average velocities of the developing corona streamers at a voltage of 12.0 kV were 2.05E8 cm/sec in the positive and 0.61E8 cm/sec in the negative, respectively. Moreover, when the negative pulse voltage was applied to the needle point the formation time lag of the cathode fall was about 10 nsec and the resulting high densities of the positive and the negative charges induced a back discharge. 20 Refs.

Primary Keywords: Surface Flashover; Corona; Polarity Effect; Dust Figure Technique; Corona Velocity; Point Cathode  
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7294  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
SELF-ACCELERATION EXPERIMENT BY INTERRUPTION OF AN INTENSE ELECTRON BEAM  
S.A. Grishchenko, V.V. Zakutyn, M.N. Masanov, A.A. Rukhtvanski and A.M. Shenderovich  
Soviet Technical Institute, Academy of Sciences of the Ukrainian SSR, Kiev, USSR  
Soviet Technical Physics Letters, Vol. 1, No. 7, pp 275-276 (07/1975)  
Trans. from: Pis'ma Zhurnal Tekhnicheskoi Fiziki 1, 612-615 (July 1975)

One of the most promising methods of accelerating a strong current electron beam is self-acceleration with the aid of an accelerating system excited by the beam. In the published experiments on self-acceleration of kilovolt electron beams it is found that the beam energy is increased by less than two times. The present paper is a brief summary of the results of experiments on self-acceleration of a beam of 100 kV electrons. It is shown that self-acceleration is followed by excitation of an accelerating system by the beam. The use of a current pulse of high-intensity electrons in a beam in which a much larger energy increment is obtained. 8 Refs.

Primary Keywords: E-beam Generation; Self-acceleration; Short Trailing Edge; Beam Energy Measurement; Gun Voltage; Gun Current; Tank Circuit  
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7292  
(PARTICLE BEAMS, ELECTRON; PARTICLE BEAMS, ELECTRON)  
(Generation; Diagnostics)  
THE GENERATION AND DIAGNOSIS OF PULSED RELATIVISTIC ELECTRON BEAMS ABOVE 1E11 WATTS

S.E. Graybill and S.V. Nablo  
Ion Physics Corp, Burlington, MA 01803  
IEEE Transactions On Nuclear Science, Vol. NS-14, No. 3, pp 782-788 (06/1967)

A review of the several approaches to the generation of intense electron streams in the megavolt energy regime is presented. The techniques used in the diagnosis of the 30,000 ampere, 3 MeV beam from a gas insulated coaxial system with a characteristic pulse length of 25 nanoseconds are discussed. The general features of such a stream drifting under self-focused conditions are presented and the results compared with the theory of such an idealized beam. The results of work conducted with cathode arrays of varying geometry are discussed. In particular, the dynamics of 20,000 ampere streams at 2 MeV from arrays with 1 cm x 6.4 cm are presented. Based on these data, a prognosis is made for the limitations of future high peak power electron accelerators at energies in the 10 MeV range. 8 Refs.

Primary Keywords: E-beam Generation; E-beam Diagnosis; 3 MeV Beam Energy; 30 kA Beam Current; 25 ns Pulse Length; Self-focusing; Cathode Array

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7296  
(POWER CONDITIONING)  
(Saturable Reactors)  
THE USE OF SATURABLE REACTORS AS DISCHARGE DEVICES FOR PULSE GENERATORS  
M.S. Melville  
British Thomson-Houston Co., Ltd.  
Proceedings Of The IEE, Vol. 98, Part III, No. 53, pp 185-208 (05/1951).  
The use of saturable reactors as pulse sharpening elements is the subject of this paper. The author begins with a short historical background of saturable reactor uses and proceeds to define the requirements of such a reactor for pulse sharpening technique. The hysteresis loops of typical magnetic materials are studied with pulse sharpening in mind. A study of several parameters is presented, as well as several possible applications. 8 Refs.  
Primary Keywords: Saturable Reactors; Recurrent High-power Pulse Generation; Electronic Discharge Devices; Historical Background; Post-pulse Oscillations; Pulsator Circuits; Long Life; Instantaneous Operability; Added Condenser Bulk.  
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7298  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
ULTRAFAST HIGH VOLTAGE PROBE  
G.E. Leavitt, J.D. Shipman and I.M. Vitkovitsky  
Naval Research Lab., Washington, DC 20375  
The Review Of Scientific Instruments, Vol. 36, No. 9, pp 1371-1372 (09/1965).  
We have developed high voltage probes that have operated in a range of 10 to 600 kV. The high frequency response of the probe was determined to be about 500 MHz. These probes have been applied in exploding wire and theta-pinch work. The probes consist of a capacitive voltage divider to a level at which single non-inductive 4-in resistors can be used. One such resistor in series with the transmission line, terminated by a matched recording oscilloscope input impedance, serves both as an additional voltage divider and as a part of an RC network with a time constant chosen to be much longer than the pulses to be measured. 5 Refs.  
Primary Keywords: Voltage Probe; Capacitive Divider; Resistive Divider/Terminator; 100 kV Operating Voltage; 18 MHz Bandwidth.  
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7300  
(BREAKDOWN STUDIES)  
(Liquid; Electrical)  
"DIFFUSION" ELECTRODES FOR INVESTIGATION OF THE BREAKDOWN OF LIQUID DIELECTRICS  
D.D. Rylov  
Journal Of Applied Mechanics And Technical Physics, Vol. 13, No. 4, pp 596-597 (08/1972).  
Trans. From: Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki 4, 186-187 (July-August 1972).  
A method which excludes the effect of electrode microinhomogeneity on the breakdown of a liquid is proposed. The method consists in forming at the surface of each electrode a transitional layer with a conductivity which gradually decreases with increasing depth in the liquid. 1 Refs.  
Primary Keywords: Liquid Breakdown; Diffusion Electrodes; Electrode Effects Eliminated; Transitional Layer; Electrical Conductivity; Spatial Resolution.  
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7303  
(BREAKDOWN STUDIES; INSULATION; MATERIAL)  
(Liquid; Electrical; Liquid)  
INCREASE OF DIELECTRIC STRENGTH OF WATER IN A SYSTEM WITH "DIFFUSION" ELECTRODES  
V.V. Vorob'ev, V.A. Kapitonov and E.P. Kruglyakov  
Nuclear Physics Institute, Academy of Science of the USSR, Moscow, USSR  
JETP Letters, Vol. 19, No. 2, pp 58-59 (01/1974).  
Trans. From: ZhETF Pis'ma V Redaktsiyu 19, 95-96 (January 1974).  
Results are presented of an investigation of the dielectric strength of pure water when the electrodes are shielded with thin conducting layers. It is established that shielding the electrode surfaces greatly increases the electric strength of water. 2 Refs.  
Primary Keywords: Dielectric Strength; Diffusion Electrodes; Liquid Surface Shielding; Surface Breakdown; Field Intensity Calculations; Diffusion Layer.  
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7315  
(BREAKDOWN STUDIES)  
(Gas; Electrical)  
DEVELOPMENT OF SPARK IN AIR FROM A NEGATIVE POINT  
E. Hestner  
Soviet State University, Juss. IA 50010  
Journal Of Applied Physics, Vol. 42, No. 7, pp 2839-2847 (06/1971).  
A point phenomenon used as a new detecting and diagnostic technique has been applied to the study of the voltage breakdown of air between a point cathode and a positive plane. "Feathers" were found to propagate at velocities almost 5% of the velocity of light. When they approach the positive plane, they produce "retrograde streamers" that bridge the gap and eventually lead to the completion of a plasma channel of high conductivity. 12 Refs.  
Primary Keywords: Point-plane Gap; Air Gap; Streamer; Very High Propagation Velocity; Retrograde Streamer.  
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7385  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES)  
(Vacuum; Electrical; Electronics)  
EFFECT OF ELECTRODE TEMPERATURE ON MICRODISCHARGES IN VACUUM  
V.I. Gordinenko and L.I. Pivovarov  
Soviet Physics-Technical Physics, Vol. 11, No. 2, pp 273-274 (08/1966).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 36, 374-376 (February 1966).  
The effect of the temperature of metal electrodes on the breakdown voltage in microdischarges in vacuum was investigated. It is shown that higher electrode temperature means higher threshold voltage (starting at 150-200 E.V.). Contamination of the electrode surface is considered as a possible cause. A significant difference in the nature of microdischarges is observed when hot cathodes are used. 7 Refs.  
Primary Keywords: Microdischarge; Breakdown Voltage; Electrode Effects; Temperature Effect; Heated Anode; Heated Cathode.  
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7433  
(PARTICLE BEAMS; ION)  
(Generation)  
NEW TYPE OF ACCELERATOR FOR HEAVY IONS  
G.S. Jones, R.H. Levy, H.A. Bethe and B.T. Feld  
Avco Everett Research Lab., Inc., Everett, MA 02149  
Physical Review, Vol. 145, No. 3, pp 925-952 (05/1966).  
A new device, called the heavy ion plasma accelerator (HIPAC) which may be capable of accelerating ions of any atomic number to energies sufficient to overcome the nuclear Coulomb barrier, is described. A closed potential well is created by filling a triaxial vacuum chamber with electrons; the electrons are contained by a magnetic field whose intensity is so low that its effect on the ions can be neglected. Ions are both accelerated and trapped in the well; the trapping effect allows sufficient time for the ions to become highly stripped by electron impact. The very large ion energies that can be achieved in this way would allow a wide variety of nuclear reactions to be studied, including inverse fission. The present primitive state of development of the HIPAC is described, and the future prospects assessed. 31 Refs.  
Primary Keywords: Ion-beam Generation; High Particle Ionization; Heavy Ion Plasma Accelerator; High Energy; Toroidal Geometry; Magnetic Field.  
Secondary Keywords: Nuclear Fusion.  
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7447  
(PARTICLE BEAMS; ELECTRON)  
(Generation)  
PHYSICAL PROPERTIES OF THIN-FILM FIELD EMISSION CATHODES WITH MOLYBDENUM IONS  
C.A. Spindt, J. Brodie, L. Humphrey and E.P. Westerberg  
Stanford Research Institute, Menlo Park, CA 94025  
Journal Of Applied Physics, Vol. 47, No. 12, pp 5248-5263 (12/1976).  
Field emission cathodes fabricated using thin-film techniques and electron beam microphotography are described, together with effects obtained by varying the fabrication parameters. The emission originates from the tip of molybdenum cones that are about 1.5 micron tall with a tip radius around 500 Å. Such cathodes have been produced in closely packed arrays containing 100 and 5000 cones as well as singly. Maximum currents in the range 50-150 microamperes per cone can be drawn with applied voltages in the range 100-300 V when operated in conventional ion-pumped vacuum at pressures of 1E-9 Torr or less. In the arrays, current densities (averaged over the array) of above 10 A/sq cm have been demonstrated. Life tests with the 100-cone arrays drawing 2 mA for 3 A/sq cm have shown for 3 A/sq cm have proceeded in excess of 1000 h with about a 10% drop in emission current. Studies are presented of the emission characteristics and current life limitation phenomena. It is tentatively concluded that the emission arises from only one or a few atomic sites on the cone tips. 37 Refs.  
Primary Keywords: Beam Generation; Thin Film Cathode; Molybdenum Cones; 10 A/sq cm Current Densities; Cone Arrays.  
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7470  
BASIC PRINCIPLES GOVERNING THE DESIGN OF MAGNETIC SWITCHES  
D.L. Birk, E.J. Lauer, L.L. Reginato, J. Schmidt and M. Smith  
Lawrence Livermore Lab., Livermore, CA 94550  
(11/1980)  
Availibility: UCID-18831  
NTIS  
The idea of using saturable reactors as the basis of high power pulse generators is not a new concept, but there have been few recent applications of this technology. Here the principle of magnetic pulse generation is briefly described and some of the basic guidelines used to design these circuits are discussed. A demonstration of the principle by a small scale pulse amplifier is presented, and finally there is an examination to a large scale system. EPA citation 15-064475.  
Primary Keywords: Pulse Generators; Design; Operation.  
Secondary Keywords: FRDA426860; NTIS.

7474  
(ENERGY STORAGE; CAPACITIVE)  
(Capacitor)  
HYDROMAGNETIC CAPACITOR  
G. Buehler, M.K. Fisher, A. Bratenahl, H.P. Furth and M.B. Kunke  
Lawrence Berkeley Lab., Berkeley, CA  
Journal Of Applied Physics, Vol. 50, No. 2, pp 188-196 (02/1955).  
Very high electric constants can easily be achieved by means of a plasma in a strong magnetic field. When an orthogonal electric field is applied, the resultant particle drift stores electrical energy in a coaxial capacitor, which makes use of a rotating plasma disk. Dielectric constants in the range 1E6 to 1E8 have been measured. The potential usefulness of hydromagnetic capacitors in fast-discharge work is considered. 8 Refs.  
Primary Keywords: Capacitor Design; Magnetically Confined Plasma; 1E6 Dielectric Constant; Very High Energy Density Capacitor.  
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7485  
(PULSE GENERATORS)  
(Reviews)  
PULSE POWER REQUIREMENTS FOR LASER ISOTOPE SEPARATION  
R.M. Pace and W.L. Willis  
Los Alamos National Lab., Los Alamos, NM 87545  
1974 IEEE Thirteenth Modulator Symposium, pp 274-276 (06/1978).  
Laser systems being developed for laser isotope separation applications have pulse power requirements which will demand the ultimate capability of pulse power technology. Although the energy per pulse is small by many pulse power standards, the requirement for currents in excess of 100 kA, voltage of about 100 kV, and pulse repetition rates of 1 kHz constitute a set of requirements not previously imposed on pulse power systems. In this paper measurements made at low repetition rates on excimer laser discharges are presented, and the implications for pulse power components are discussed. Currently available switches and energy storage systems are discussed, and requirements for future development are given. 0 Refs.  
Primary Keywords: Laser Loads; Pulsed Power Requirements; Switching; Energy Storage; Repetition Rate.  
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7487  
(PARTICLE BEAMS, ELECTRON)  
(Transport)  
EXTENDED WORKING RANGE FOR ELECTRON BEAMS IN THE ATMOSPHERE  
J.F. Lowry and E.M. Schumacher  
Westinghouse Research and Development Center, Pittsburgh PA  
Nuclear Instruments And Methods 130, pp 577-596 (09/1975).  
The range and the power density at a given work distance for a high power electron beam outside the vacuum depend upon a number of factors besides the beam voltage, for instance temperature (i.e. density) and composition of the atmosphere in which the beam travels. These factors were investigated experimentally. The heating of the air in the beam path by a high power beam itself can increase the range by as much as a factor of 2 and the power density at a given distance from the electron gun by a factor of 10. This heating of the gas can be enhanced by surrounding the beam path by a fairly wide guard-tube through which, in addition, helium may be flowed. Another way to create a high temperature low atomic number path for the beam consists of a coaxial hydrogen flame. With these devices we found the range could be extended by a total factor of 3, and the power density for a given total power increased by a factor of about 50. The results of the present measurements agree with earlier theoretical calculations, as far as applicable. We also found that the visible fluorescent beam plume gives a misleading impression: it is much wider than the actual scatter-broadening of the high-energy electron component of the beam. 10 Refs.  
Primary Keywords: Beam Propagation; Air; Parameter Study; Simulation; Numerical Calculation; Optimization  
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7489  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
THE CURRENT IN A CYLINDRICAL RELATIVISTIC DIODE  
N.W. Harris  
Ion Physics Corp, Burlington, MA 01803  
Journal Of Physics D: Applied Physics, Vol. 13, pp 789-792 (10/1979).  
The current in a space-charge-limited cylindrical diode working at very high voltages has been calculated. The results are presented graphically for a wide range of electrode diameter ratios and for voltages up to 10 MV. The results are given for the exterior cathode and interior cathode configurations. 9 Refs.  
Primary Keywords: Diode; Space-charge-limited; Current Measurement; Several Electrode Diameters; Radially Convergent Beam  
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7490  
(BREAKDOWN STUDIES)  
(Liquid, Electrical)  
THE EFFECT OF ORGANIC ADDITIVES ON THE BREAKDOWN AND GASSING PROPERTIES OF MINERAL OILS  
A.A. Zaky, I.Y. Magahed and C. Evangelou  
University of Alexandria, Alexandria, Egypt  
Journal Of Physics D: Applied Physics, Vol. 9, pp 841-850 (11/1976).  
The effect of organic additive content on the direct voltage breakdown strength of degassed transformer oil and liquid paraffin is reported for a wide range of concentration of additives known to be effective gassing inhibitors. Their effect on the breakdown strength of oils saturated with hydrogen, nitrogen and oxygen is also reported. Measurements of the gassing properties of the oils were carried out for the same extended range of additive concentrations. The observed breakdown and gassing versus concentration characteristics indicate the presence of maximum and minimum points at concentrations which are independent of the matrix liquid and of dissolved gas and gas phase. There is a remarkable degree of correlation between the breakdown and the gassing properties of the liquids tested. This and other relevant observations indicate that gas generation is an intrinsic part of the breakdown process and strongly support the bubble theory of breakdown. This forms the basis for the discussion of the results. 20 Refs.  
Primary Keywords: Organic Additives; DC Voltage; Degassed Oil; Gas-saturated Oil; Gassing-breakdown Correlation  
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7491  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Electrodes; Gas Gaps; Materials)  
THE EFFECT OF ROTATING ARC VELOCITY ON COPPER CATHODE EROSION  
A.E. Guile and A.M. Hitchcock  
Leeds University, Leeds, UK  
Journal Of Physics D: Applied Physics, Vol. 7, pp 597-601 (01/1974).  
In a number of devices, transverse magnetic fields are used to rotate arcs to minimize electrode erosion. Measurements are reported here for 45 A arcs rotating in air at atmospheric pressure which show that the cathode loss, which exceeds that of the anode, can be determined with good accuracy if allowance is made for oxidation. These results, which have been made over a much wider range of arc velocity than in work reported previously, show that the variation of cathode erosion rate with arc velocity is not a simple one, and that an abrupt fall or increase can occur for a very small change in arc velocity. It is suggested that it has commonly been assumed that increasing the magnetic field will continuously reduce the loss of electrode material. It is suggested that these considerable variations in cathode erosion are associated with changes in electron emission caused by differing oxide film conditions on the cathode surface. 23 Refs.  
Primary Keywords: Rotating Arc; Magnetically Driven; Atmospheric Air; Low Current; Wide Air Velocity Range  
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7492  
(SWITCHES, CLOSING; BREAKDOWN STUDIES)  
(Vacuum Gaps; Electrical; Vacuum, Electrical)  
THE EFFECT OF TEMPERATURE ON THE ELECTRICAL CHARACTERISTICS OF A VACUUM GAP  
D.A. Swift  
Central Electricity Research Labs, Leatherhead, Surrey, UK  
Journal Of Physics D: Applied Physics, Vol. 5, pp 1585-1591 (05/1972).  
An experiment has been done in which the electrodes of a vacuum gap were operated at widely different temperatures over a range 4 to 390 Deg K. The temperatures of both the anode and cathode were found to affect the prebreakdown current and breakdown voltage of a 0.8 mm uniform field gap between niobium electrodes of industrial surface finish. 7 Refs.  
Primary Keywords: Temperature Effects; 4-300 Deg K Range; Prebreakdown Current; Breakdown Voltage; Uniform Field Gap; Niobium Electrodes  
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7493  
(SWITCHES, CLOSING)  
(Thyratrons)  
THE HOLLOW THERMIONIC CATHODE SYSTEM USED IN THYRATRONS  
J. Gower  
MO Valve Co, London, UK  
Journal Of Physics D: Applied Physics, Vol. 3, No. 9, pp 137-139 (07/1970).  
A simple explanation for the high currents obtained from hydrogen thyratron cathodes is put forward. It is suggested that the "hollowness" of the cathode structure and the high secondary emission coefficient for low energy hydrogen ions incident on barium covered surfaces leads to a self-maintained discharge with a modest running voltage. This static theory does not explain the large amplitude oscillations (about 160 MHz) that have been observed in the cathode region of thyratrons during the first 0.2 microsecond of pulsed discharges. 3 Refs.  
Primary Keywords: High Cathode Current; Analysis; Secondary Emission; Self-maintained Discharge  
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7494  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
THE MECHANISM OF ELECTRICAL BREAKDOWN OF GASES, INITIATED BY A LARGE NUMBER OF ELECTRONS  
P. Sulzbach and R. S. N.  
Indian Institute of Science, Bangalore, India  
Journal Of Physics D: Applied Physics, Vol. 5, pp 2055-2063 (07/1972).  
The mechanism of breakdown in uniform fields was investigated by pressure, using a large number of initial electrons (approximately  $1E6$ ) released from the cathode as a delta function at the start of a high-voltage rectangular pulse applied to the discharge gap. The threshold breakdown voltages were about 30% higher than the 10 breakdown voltages reported by others. The formative times at threshold and at overvoltages indicated that up to a critical overvoltage, breakdown takes place by the multiple-avalanche Townsend mechanism, due to a photoelectric secondary effect at the cathode. The magnitudes of the critical overvoltages were not significantly less than those with a single initial electron obtained by other workers. For overvoltages higher than the critical, there was a transition region, at the end of which, breakdown transforms to the single-avalanche streamer mechanism. 17 Refs.  
Primary Keywords: Uniform Field; Several Gases,  $1E6$  Initiating Electrons; Formative Time Log; Single-avalanche Streamer  
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7495  
(SWITCHES, CLOSING)  
(Gas, Electrical)  
THE PARALLEL OPERATION OF LOW-INDUCTANCE HIGH-CURRENT SPARK GAPS WITHOUT TRANSIT TIME ISOLATION  
P.M. Barnes, J.E. Gruber and T.E. James  
Culham Lab, Didington, Oxfordshire, UK  
Journal Of Scientific Instruments, Vol. 44, pp 599-605 (03/1967).  
The necessary conditions for the satisfactory parallel operation of spark gaps, with no transit time isolation between them, are deduced theoretically. Such a capacitor bank with closely connected parallel spark gaps has been operated successfully. The development of a 60 kV pressure and field-distortion spark with an inductance of 15-18 nH is described, and the influence of electrode arrangement and trigger circuit parameters on breakdown time and jitter has been investigated. 8 Refs.  
Primary Keywords: Close Coupling; Field Distortion Gap; Low-inductance; Variable Geometry; Variable Trigger Parameters; Experiment; Theory  
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7496  
(ENERGY STORAGE, MECHANICAL)  
(Rotating Machines)  
TESTING AND ANALYSIS OF A FAST DISCHARGE MONOPOLAR MACHINE (FDX)  
J.M. Bullen, K. Zowarka, M.D. Driscoll, J.H. Gully, M.G. Rylander, K.M. Folke, W.C. Eakin and H.W. Woodson  
University of Texas at Austin, Austin, TX 78712  
2nd IEEE International Pulsed Power Conference Proceedings, pp 333-342 (06/1979).  
The Fast Discharge Experiment (FDX) is a 0.36 MJ, 200 V monopolar machine designed to discharge in one millisecond. This experiment is intended to establish the fundamental limitations involved in converting energy in the shortest time from a flywheel using homopolar conversion. FDX features a room temperature 1.65 A-t copper coil pulsed by a 5 MJ slow discharge homopolar machine, two 30.2 cm diameter counterrotating aluminum rotors with flame sprayed copper slip rings, low inductance return conductors, coaxial transmission line, four fast closing (30 microseconds) 1/2 MA making switches, hydrostatic journal bearings, squeeze film thrust bearings and dual brush activation systems. After initial testing of FDX was completed and data was analyzed, problems limiting performance were identified. Various components of the machine were redesigned and modified to correct these problems. A second set of tests, including short circuit discharges from various speeds, has recently been conducted. Results and analysis of these tests will be presented. New problems encountered as well as recommendations for additional work will also be given. 6 Refs.  
Primary Keywords: Homopolar Generator; Aluminum Rotor; Copper Slip Ring; Hydrostatic Journal Bearing; Analysis; Performance Limitations  
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7498

(BREAKDOWN STUDIES)  
(Liquid, Electrical)

ELECTRICAL CONDUCTIVITIES AND BREAKDOWN RESISTANCE OF MIXTURES OF SOME LIQUID DIELECTRICS UNDER VOLTAGE PULSES

Yu. A. Korsunovskii and A. A. Protodkov  
Applied Electrical Phenomena, No. 4, pp 257-261 (08/1967).  
Trans. From: Elektronnaya Obrabotka Materialov 4, 29-34 (July-August 1967).

Studies of the breakdown resistance of liquid dielectrics began long ago, but only in 1941 was it discovered by Rühle that certain concentrations of some polar substances increased the breakdown resistance of n-hexane to an alternating voltage of frequency 50 cps. Geng and coworkers observed an increase of 30% in the breakdown resistance of n-hexane with an admixture of 5% ethyl alcohol. This result was obtained for a constant voltage. Kao and Hsueh established that the addition of 5% carbon tetrachloride, chlorobenzene, chloroform, or ethyl alcohol increased the breakdown resistance of n-hexane, measured for voltage pulses, by 35%, 28%, 13%, and 7%, respectively. Electrical conductivities and breakdown resistance  $E_{50}$  of mixtures of carefully purified n-hexane with n-octane, benzene, m-xylene, chlorobenzene, chloroform, and carbon tetrachloride were studied as functions of the concentrations of these solutes. Measurements of electrical conductivity in pre-breakdown fields and breakdown resistance were carried out with voltage pulses of rectangular shape and 6 microsecond durations. Isolated pulses being used. Analytical grade and chemically pure materials were used as solutes, being filtered through a No. 3 glass filter.

Primary Keywords: Liquid Dielectrics; N-hexane; Mixture; Polar Dielectric; Non Polar Dielectric; Parallel-plane Electrodes; Short Gap

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7503

(ENERGY STORAGE, MECHANICAL)

(Rotating Mechanical Materials)

DESIGN OF BRUSH GEAR FOR HIGH CURRENT PULSES AND HIGH RUBBING VELOCITIES

C. A. Marshall

Australian National University, Canberra, Australia

IEEE Transactions On Power Apparatus And Systems, Vol. PAS-85, No. 11, pp 1177-1187 (11/1966).

This paper describes the mechanical brush gear designed for carrying the 1.6 million-ampere 1-second pulses from the rotors of the Canberra homopolar generator. Current density in the copper graphite brushes rises to about 10000 A/sq in. at full current. The brushes are also required to operate at rubbing speeds of up to 33000 ft/min. The experiments that were made to set the design limits for the brushes and the results obtained from these experiments are described; the design requirements and details of the brush gear as manufactured are given, and their operation in the homopolar generator is discussed. 7 Refs.

Primary Keywords: Homopolar Generator; Brush Gear Design; 10 kA/sq in. Brush Current Density; 33000 ft/min Rubbing Velocity; Performance Test

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7506

(BREAKDOWN STUDIES)

(Gas, Electrical)

DEVELOPMENT OF OVERVOLTAGE BREAKDOWN AT HIGH GAS PRESSURE

E. E. Kunhardt and W. M. Rostkowski

Texas Tech University, Lubbock, TX 79409

Physical Review A, Vol. 21, No. 6, pp 2369-2377 (04/1980).

A model for the development of electrical breakdown in dense gases is presented. It determines the initial phase of breakdown in the regime where the Townsend avalanche mechanism does not apply. The main features of the model are as follows: (1) It gives a continuous picture of the development both in the structure of the breakdown and the physics of the processes; and (2) it is based on electron kinetics, so that the theory is general in nature. In light of this model a brief discussion of experimental results is given. 25 Refs.

Primary Keywords: Gas Breakdown; High Pressure Gas; Townsend Avalanche; Streamer Theory; Theory; Electron Kinetics

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7508

(BREAKDOWN STUDIES; SWITCHES, OPENING)

(Exploding Wires; Explosive Fuses)

EFFECTS OF SURROUNDING MEDIUM ON ELECTRICALLY EXPLODED ALUMINUM FOIL

J. L. Berger

Naval Surface Weapons Center, Dahlgren, VA 22448

IEEE Transactions On Plasma Science, Vol. PS-8, No. 3, pp 213-216 (09/1980).

Flat aluminum foil fuses were exploded electrically by discharges at 500 nA and 500 V. A series combination of two fuses (approximately 500 nA x 2.54 x 2.54 x 0.02) cm fuses were exploded in a sealed chamber. The time-to-burn (TTB) and fuse voltage characteristics were investigated as a function of the fuse environment. Results are given for fuses exploded in various gases and in vacuum. 17 Refs.

Primary Keywords: Aluminum Foil Fuses; Environmental Effects; Several Gases; Several Liquids; Fuse Voltage vs Time

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7509

(BREAKDOWN STUDIES)

(Vacuum, Electrical)

ELECTRICAL BREAKDOWN IN HIGH VACUUM

W. S. Boyle, P. F. Smith, and J. R. Schermer

Bell Labs, Murray, NJ 07974

Journal Of Applied Physics, Vol. 58, No. 6, pp 720-724 (06/1985).

Currents preceding breakdown have been measured between closely spaced tungsten electrodes in high vacuum. It is found that field emission currents sufficient to evaporate and melt metal flow before breakdown. These currents follow the Fowler-Nordheim equation when field magnification due to surface irregularities on the cathode is taken into account. The field magnification is a function of distance at electrode separations less than 4E-4 cm. Calculation of the observed breakdown field voltage and small arcing requires an unusually high value of emitting area of the cathode per unit area of the gap. Furthermore, there is no measurable direct enhancement of the current by ionization at higher voltages. The high electron yield must therefore occur over the entire observed range of breakdown voltages. The high yield is satisfactorily accounted for by the presence of a small area of high positive ionization on the cathode, which produces the positive ion current density until there is breakdown. It is shown that breakdown occurs when the field emission current is increased by only 45 percent. This condition is reached with the ion current density much smaller than the electron current density. 5 Refs.

Primary Keywords: Breakdown Current; Tungsten Electrodes; Field Emission; Ion Evaporation; Ion Evaporation; Ion Evaporation

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7515

(BREAKDOWN STUDIES)

(Liquid, Electrical)

EXFIB: A STUDY OF ELECTRICAL BREAKDOWN IN WATER IN THE MICROSECOND REGIME

D. B. Feinman and R. J. Grisham

Naval Surface Weapons Center, Dahlgren, VA 22448

IEEE Transactions On Plasma Science, Vol. PS-8, No. 3, pp 209-213 (09/1980).

This paper presents experimental results from research on electrical breakdown carried out at NSWC/DL. The experimental apparatus is described in some detail. Results from approximately two thousand tests are presented. Breakdown events were observed predominantly in the 2-10 microsecond regime for applied fields in the range 150-500 kV/cm. The shot-to-shot variation of breakdown time intrinsic to the phenomena requires statistical measures of performance. The performance of four electrode materials—copper, brass, stainless steel, and aluminum—is presented. The first three performed similarly; aluminum was significantly different. 7 Refs.

Primary Keywords: Water Breakdown; 2000 Breakdowns; Microsecond Regime; Copper Electrode; Brass Electrode; Stainless Steel Electrode; Aluminum Electrode; 500 kV/cm E-field

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7545

(BREAKDOWN STUDIES)

(Expanding Wires)

CHARACTERISTICS OF ENERGY RELEASED IN A CHANNEL FORMED BY AN EXPLODING WIRE

V. M. Ocheretin

ISU Report No. F510-MT 23 131-74 (05/1974).

Trans. From: Elektronnaya Obrabotka Materialov 3, 74-75 (1973)

Available in: AD A05559

NII

A theoretical study is made of the conditions for energy release in a channel formed by an exploding wire, at which the maximum power is successfully obtained. It was found that the energy density in the channel is determined mainly by the magnitude of the discharge current and the discharge channel radius, and that the energy density is greater in materials with greater magnetic permeability, i.e., steel or iron, rather than copper, aluminum or brass. The study showed that the skin effect can be disregarded. The curve of the instantaneous power given off in the channel can be plotted from current and voltage oscillograms, and the equations used show that high-voltage, low-capacitance capacitors are preferable to low-voltage, high-capacitance ones. It is shown that the pressure at the channel boundary can be determined, which permits proceeding to calculation of the hydrodynamic pulse parameters. 5 Refs.

Primary Keywords: Exploding Wire; Plasma Channel; Theory; Numerical Calculations; Dependence On Current Magnitude; Dependence On Wire Material

7546

A STUDY OF POWER AND ENERGY IN THE AURORA MODIFICATION PROJECT

J. D. J. Shipman

Naval Research Lab., Washington, DC 20375

Final Report, NSL-MR-4781, 28p (07/1980).

Availability: AD A078 051/8

NII

This report summarizes the results of a series of computer runs at NRL which were designed to determine if the measured loss of power and energy in the Aurora Modification Project tests in the fall of 1978 was due to increasing capacitance in the water switches during the transit times or the streamers or was due to resistive losses in the water switches. From the results of these analyses, it is concluded that the losses were mainly due to resistance in the intermediate stream and pulse forming liner output switches and that the changing switch capacitance merely rounded the pulse shapes near the peak values without contributing to a major loss of energy. It is suggested that oil switches be considered as a replacement for the water switches since they have less loss, although there are risks and problems involved in their use. (Author)

Primary Keywords: Pulse Generators; Electromagnetic Pulses; Electronic Switches; Transmission Lines; Computations; Computer Applications

Secondary Keywords: Aurora Gamma Ray Facility; Nanosecond Time; 1000 Hz

7557

(REVIEWS AND CONFERENCES, ENERGY STORAGE; POWER CONDITIONING; SWITCHES)

(Conferences; Reviews; Reviews)

ENERGY STORAGE, COMPRESSION, AND SWITCHING

W. L. J. J. (Ed.) (1), V. Nardi (Ed.) (1) and O. S. F. Zucker (Ed.) (2)

Plenum Press, New York and London (01/1976).

Plenum Press, New York and London (01/1976).

This volume contains the proceedings of the conference on energy storage and compression, switching, particle beam generation and plasma physics. Pulsed power systems for the generation of beams are presented in several papers, as is the use of collective effects for ion acceleration. The plasma focus is considered as both a plasma device and as a source of beams. Flux compression is considered both as a source of electrical power and as a means of producing intense magnetic fields. Capacitive and inductive energy storage systems are, of course, well represented. Several kinds of closing switches and exploding wire opening switches are considered in some detail. 64 Refs.

Primary Keywords: Energy Storage; Inductive Energy Storage; Homopolar Generator; Thyristor; Gas Spark Gap; Oil Spark Gap; Exploding Wire

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7561  
(BREAKDOWN STUDIES; INSULATION, MATERIAL)  
(Solid, Electrical; Solid)  
ELECTRODE-LIMITED AND SPACE-CHARGE-LIMITED TRANSIENT CURRENTS IN INSULATORS  
S. Z. Weiss (1), A. Cobas (1), S. Trester (2) and A. Many (3)  
(1) Puerto Rico Nuclear Center, San Juan, Puerto Rico  
(2) University of Puerto Rico, Rio Piedras, Puerto Rico  
(3) Hebrew University, Jerusalem, Israel  
Journal Of Applied Physics, Vol. 19, No. 5, pp 2296-2302 (4/1968).  
The equations governing the transient-current flow in insulating crystals are solved for two categories of boundary conditions corresponding to situations in which the current is partly space-charge controlled and partly electrode limited. The carrier-reservoir at the injecting electrode is assumed to arise from photoexcitation by a pulse of highly absorbed light. In one category, the light intensity is taken to be sufficiently strong such that initially the current is completely space-charge limited; the time dependence of the current after the collapse of the carrier reservoir is calculated, with the time interval elapsed between the onset of the light pulse and the reservoir collapse taken as a parameter. The other category considered corresponds to sufficiently weak pulse excitation such that the field at the illuminated electrode is never zero. The duration of the pulse for this category is assumed to be short compared to the carrier transit time. The time and voltage dependence of the current is calculated in this case in the presence of surface recombination. Both categories of boundary conditions are often encountered in practice, and a comparison between theory and experiment is expected to yield valuable information on carrier generation and recombination processes at the surface. 9 Refs.  
Primary Keywords: Insulating Crystals; Space Charge Limited Current; Electrode Limited Current; Electrode Illumination  
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7568  
GENERATING HIGH VOLTAGE PULSES BY INTERRUPTING CURRENT IN AN INDUCTIVE CIRCUIT  
M. Friedman and M. Ury  
Naval Research Lab, Washington, DC 20375  
Interim report, No. NRL-MR-3326, 14p (07/1976).  
Availability: AD-A028 075/05T  
NTIS  
A new approach to the problem of developing an opening switch for inductive systems is described. The switch consists of an aluminum foil immersed in water. Heat transfer processes and chemical reactions between the Al and water determine switch performance. Six kilojoules of electrical energy was handled by the switch and voltages of up to 100 kV were generated across the switch electrodes. (Author)  
Primary Keywords: Pulse Generators; Interrupters; Electric Switches; Inductors; Energy Storage; High Power; Fuses(Electrical); Aluminum; Foils(Materials); Immersion; Water; Heat Transfer; Chemical Reactions; Electric Power  
Secondary Keywords: Inductive Storage; NTISDDCA

7570  
(ENERGY STORAGE, INDUCTIVE; POWER CONDITIONING)  
(Inductors; Pulse Transformers)  
HALF-MEGAJoule MAGNETIC-ENERGY-STORAGE PULSE GENERATOR  
R.C. Walker and H.C. Early  
University of Michigan Research Institute, Ann Arbor, MI  
The Review Of Scientific Instruments, Vol. 29, No. 11, pp 1020-1022 (11/1958).  
Energy is stored in the magnetic field of a large air core transformer having a very low impedance, tightly coupled secondary winding. The energy can be effectively delivered in less than 5 msec to a noninductive load having a resistance of less than 1E-4 ohm. 2 Refs.  
Primary Keywords: Pulse Transformer; Inductive Energy Store; Resistive Load; 5 ms Pulse Length  
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7574  
(PULSE GENERATORS; ELECTROMAGNETIC LAUNCHERS)  
(Rotating Machines; Relays)  
HOMOPOLAR CURRENT SOURCE FOR MASS ACCELERATORS  
I.M. Vitkovitsky, R.D. Ford, D. Jenkins and W.H. Cupler  
Naval Research Lab, Washington, DC 20375  
IEEE Transactions On Magnetics, Vol. MAG-13, No. 1, pp 147-159 (01/1982).  
Acceleration of submilligram mass to velocities of several km/s by magnetic forces requires a multimegajoule source of energy. Constraints associated with the length of the pulse and with the structural integrity of the accelerated mass as well as with the problem of contact erosion, bracket the accelerating time and current to the millisecond and megampere regimes, respectively. Homopolar generators (HGs) combined with appropriate switching can provide such output pulses more economically than other sources. 11 Refs.  
Primary Keywords: Mass Particle Accelerator; Rail Gun; Contact Erosion; Millisecond Current Pulse; Homopolar Generator; Transfer Switch  
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7578  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
IMPEDANCE CHARACTERISTICS OF DIODES OPERATING IN THE SELF-PINCH MODE  
G. Cooperstein and J.J. Gordon  
Naval Research Lab, Washington, DC 20375  
Journal Of Applied Physics, Vol. 46, No. 4, pp 1535-1538 (04/1975).  
The impedance characteristics of large aspect ratio diodes employing hollow field emission cathodes operating in the self-pinched mode have been studied at electron kinetic energies between 40 and 800 keV and currents between 10 and 500 kA. The importance of correcting the anode-cathode gap spacing for closure due to plasma motion is recognized and taken into account in the definition of the diode aspect ratio in impedance calculations. With this correction, the impedance at peak diode voltage and current is found to be nearly independent of voltage and cathode surface area and inversely proportional to the diode aspect ratio. Its amplitude is approximately 50% higher than that predicted by paraxial flow theory. 12 Refs.  
Primary Keywords: E-beam Generators; Field Emission Diode; Cathode; Hollow Cathode; Beam Pinching; Beam Pinch; Large Aspect Ratio Diode  
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7580  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
INTENSE FOCUSING OF RELATIVISTIC ELECTRONS BY COLLAPSING HOLLOW BEAMS  
A.E. Blugrand and G. Cooperstein  
Naval Research Lab, Washington, DC 20375  
Physical Review Letters, Vol. 34, No. 8, pp 461-464 (02/1975).  
Low-impedance diodes with hollow tapered cathodes produce strong self-pinching in intense relativistic electron beams. Early in the pulse a thin hollow beam is formed, based on evidence of electrons striking the anode. This hollow beam collapse, accelerating toward the anode axis with velocities (1 to 5 mm/nsec) which depend locally on the anode material. An efficient and stable pinch, less than 3 mm in diameter, is formed at the anode. In the center 0.1 sq cm, the power rises to 1E11 W in less than 3 nsec. About 50% of the total diode energy (approximately 9 kJ) is dissipated within the pinch region. 8 Refs.  
Primary Keywords: E-beam Generators; Hollow Cathode; Tapered Cathode; Hollow Beam; Beam Pinching; Anode Material  
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7582  
(BREAKDOWN STUDIES)  
(Vacuum; Optical)  
EVIDENCE FOR REVERSE PHOTOELECTRONS IN LASER-INDUCED CURRENT  
S.P. Lloyd  
University of Oxford, Oxford, UK  
Journal Of Applied Physics, Vol. 43, No. 1, pp 244-245 (01/1972).  
Strong experimental evidence has been obtained for the significant contribution of 'reverse photoelectrons' in the production of current signals induced by focusing laser light onto a metal target and blocking the collector negative with respect to the target. Reverse photoelectrons are essentially normal photoelectrons from the collector region. The source of these photons is the laser-produced hot spot on the target. 6 Refs.  
Primary Keywords: Laser Irradiated Anode; Thermal Radiation; Cathode Photoemission  
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7583  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
INTERACTION OF ACCELERATING HIGH-CURRENT ELECTRON BEAMS WITH EXTERNAL MAGNETIC FIELDS  
D.A. Hammer (1), W.F. Oliphant (2), I.M. Vitkovitsky (1) and V. Fargo (2)  
(1) Naval Research Lab, Washington, DC 20375  
(2) Lockheed Missile And Space Co., Palo Alto, CA 94305  
Journal Of Applied Physics, Vol. 43, No. 1, pp 58-60 (01/1972).  
When the current and current density of electrons accelerated in the anode-cathode gap of a field emission tube reach sufficiently high values, the induced self-magnetic field begins to dominate the electron trajectories. As a result, the spatial distribution of electrons arriving at the anode becomes strongly peaked in the center of the anode. It has been found possible to prevent such beam collapse with relatively modest external magnetic fields. The field is applied parallel to the electron flow (perpendicular to the anode plane) and a scaling law which determines the necessary field strength based on a simple orbit model is found to agree with experimental results over a wide range of electron-beam parameters. 8 Refs.  
Primary Keywords: E-beam Generation; Field-emission Diode; Self-magnetic Field; Beam Collapse; External Magnetic Field  
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7584  
(BREAKDOWN STUDIES)  
(Gas; Optical)  
GAS BREAKDOWN AT 10.6-MICRON-WAVELENGTH CO/SUB 2/ LASER RADIATION  
D.C. Smith  
United Aircraft Research Labs, East Hartford, CT 06118  
Journal Of Applied Physics, Vol. 41, No. 11, pp 4551-4555 (10/1970).  
The gas breakdown threshold of the minimum power density required to initialize gas with 10.6-micron-wavelength radiation has been examined using the reflection of a Q-switched CO/sub 2/ laser. The induced glow that is produced cannot initiate the breakdown process for pressures as high as 1E9 W/sq cm. If an initial low density of ionization is provided by an external source, the subsequent growth of the breakdown is in agreement with a cascade model, as evidenced by the experimentally determined gas pressure and laser-breakdown frequency dependence. 17 Refs.  
Primary Keywords: Gas Breakdown; CO/sub 2/ Laser; Breakdown Threshold; Argon Gas; Cascade Model  
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7587  
(BREAKDOWN STUDIES; INSULATION, MATERIAL)  
(Gas; Electrical; Gas)  
IMPULSE VOLTAGE TESTS ON AIR AND C/SUB 3/ F/SUB 8/  
L.C. Whitman  
South Dakota State University, Brookings, SD  
IEEE Transactions On Electrical Insulation, Vol. EI-1, No. 2, pp 44-48 (11/1965).  
There is continual need for the evaluation of the electric strength of the various new gases that are becoming available and their comparison with the electric strength of some standard such as air. The impulse voltage strength of a new gas is not easily and quickly obtained, yet is essential in the proper design of equipment using these gases. It is the purpose of this paper to describe briefly the equipment that was used for this impulse voltage testing work and to record some impulse voltage breakdown data on tetrafluoroethane (C/sub 3/ F/sub 8/) and its comparison to air. 5 Refs.  
Primary Keywords: Air Breakdown; C/sub 3/ F/sub 8/ Breakdown; Electric Strength Comparison; Test Apparatus Description  
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7588  
(SWITCHES, CLOSING)  
(Liquid Gases, Self)  
MULTIPLE CHANNEL SWITCHING IN WATER DIELECTRIC PULSE GENERATORS  
J.K. Burton, D. Conte, M.H. Lupton, J.D. Shipman Jr. and I.M.  
Vikovitsky  
Naval Research Lab, Washington, DC 20375  
1973 IEEE Proceedings Of The Fifth Symposium On Engineering Problems Of  
Fusion Research Conference Record, pp 679-683 (11/1973).  
Criteria have been developed for multiple channel switching  
without triggering of water dielectric pulse power systems. The  
channel-to-channel jitter time, the current partition between  
channels, and the mechanical integrity of the switch have been  
determined for switching high voltage pulse lines at energies up to  
30 kJ. The operation of switches has been compared for voltages  
applied for 100 and 600 nsec. The results can be projected to the  
design of IE13 W pulse generators. 7 Refs.  
Primary Keywords: Self-triggered Water Switch; Multichannel Operations;  
Performance Test; Jitter; Current Sharing  
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7594  
(SWITCHES, OPENING)  
(Mechanical)  
NEW TYPE OF ULTRAFAST CIRCUIT BREAKER: ITS PRINCIPLE AND PERFORMANCES  
P. Caupeps, C. Rioux and F. Rioux-Damida  
Lab d'Electrotechnique, Orsay, France  
The Review Of Scientific Instruments, Vol. 52, No. 1, pp 118-122  
(01/1981).  
The replacement of conventional voltage sources by inductive  
storage techniques in high-voltage pulse generation requires the  
successful operation of a suitable circuit breaker. The proposed  
device is composed of two different parts: the mechanical switch and  
the energy absorber. The magnetically activated mechanical switch  
operates in nitrogen under pressure and requires a low command energy  
(10X-15X of the primary stored energy). We present the mechanical  
switch basic principle and its performances, namely its restriking  
voltage and the power absorber which affect it. The complete circuit  
breaker (switch plus energy absorber) can be used to open  
successfully currents up to 70 kA in times less than 10 microseconds.  
The restriking voltage (here, 40 kV after 20 microseconds) is  
proportional to the number of knives and can be improved by having  
longer conductors and a large number of knives. The switch jitter is  
very low (approximately 1 microsecond). 12 Refs.  
Primary Keywords: Mechanical Opening Switch; Inductive Energy Store;  
Nitrogen Working Gas; Magnetic Activation;  
Performance Test; 70 kA Opening Current; 40 kV  
Opening Voltage  
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7605  
(BREAKDOWN STUDIES; SWITCHES, OPENING)  
(Exploding Wires; Explosive Fuses)  
RECOVERY CHARACTERISTICS OF EXPLODING WIRE FUSES IN AIR AND VACUUM  
I.M. Vikovitsky and V.E. Scherrer  
Naval Research Lab, Washington, DC 20375  
Journal Of Applied Physics, Vol. 52, No. 4, pp 3012-3015 (04/1981).  
The dielectric strength of exploded wire fuses during the  
vaporization and after recovery period and fuse resistivity are  
functions of time and depend on the medium surrounding the fuse  
channel. When fuses are used as opening switches in inductive storage  
systems, the above parameters determine the efficiency of power flow  
from the storage to the load. Specifically, design of experiments  
using loads with variable impedance, such as exploding plasma,  
requires detailed information on the fuse characteristics during the  
time when the load impedance is changing. To provide data that  
determine the interaction between fuses and variable impedance loads,  
inductive and recovery electric fields and fuse resistance in air and  
vacuum were studied. The results show that inductive field amplitude  
follows the dependence on time needed to vaporize the fuse in a  
manner similar to that established for fuses in other media. The  
characteristics of recovery rates of fuses in air and vacuum differ  
drastically due to the early onset of ionization in fuse channels in  
vacuum. 19 Refs.  
Primary Keywords: Exploding Wires; Vaporization Stage; Recovery Stage;  
Dielectric Strength; Load Considerations  
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7606  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
RELATIVISTIC ELECTRON BEAM PINCH FORMATION PROCESSES IN LOW IMPEDANCE  
DIODES  
A.E. Blaugrund (1), G. Cooperstein (1) and S.A. Goldstein (2)  
(1) Naval Research Lab, Washington, DC 20375  
(2) University of Maryland, College Park, MD 20742  
The Physics Of Fluids, Vol. 10, No. 7, pp 1185-1194 (07/1977).  
The process of pinch formation in large aspect ratio diodes has  
been studied by means of streak photography and time-resolved x-ray  
detectors. A tight pinch is formed at the anode center by a  
collapsing thin hollow electron beam emitted from a hollow cathode.  
The collapse velocity depends, amongst other things, on the type of  
material in the top 1 micron layer of the anode. In the suggested  
model it is assumed that the anode plasma is created from gases  
released from the surface layer of the anode by the heating action of  
the beam. These gases are ionized by avalanche breakdown aided by  
primary backscattered, and secondary electrons. Ions emitted from  
this plasma modify the electron trajectories in the diode leading to a  
radial collapse of the hollow electron beam. The observed monotonic  
dependence of the collapse velocity on the atomic number of the anode  
material can be explained by the smooth dependence on Z of both the  
specific heat and the electron backscatter coefficient. In the case  
of high-Z anodes the ion expansion time is calculated and shown to be  
the factor limiting the collapse velocity. The use of thin foils to  
speed up the collapse rate is suggested. Detailed experimental data  
are presented. 23 Refs.  
Primary Keywords: E-beam Generation; Hollow Cathodes; Beam Pinching;  
Anode Effects; Anode Plasma; Thin-film Anode  
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7613  
(SWITCHES, CLOSING)  
(Gas Gases, Electrical)  
THE DQ SWITCH OPERATION AT 4 MILLION VOLTS AND 800 KILOAMPERES  
J.W. Douglas, W.F.J. Grewson and C.H. Jones Jr.  
Pulsar Associates Inc, San Diego, CA 92121  
DNA Report No. DNA 5160F (12/1979)  
Availability: DNA 5160F  
NTIS  
This report describes the progress to date with high voltage gas  
switching using the DQ switch developed by Pulsar Associates.  
Incorporated. Self-breaking operation has been achieved at 4 million  
volts and 800 kiloamperes. Triggered operation has been achieved at 2  
million volts. The control of insulator tracks is described, along  
with the engineering of the switch. 6 Refs.  
Primary Keywords: DQ Switch; Gas Gap; Triatron; Multi-section; UV  
Illumination  
Secondary Keywords: Casino Simulator

7620  
(PULSE GENERATORS; SWITCHES, CLOSING)  
(Blumlein Lines; Solid Dielectrics; Electrical)  
TRAVELING WAVE EXCITATION OF HIGH POWER GAS LASERS  
J.D. Shipman Jr.  
Naval Research Lab, Washington, DC 20375  
Applied Physics Letters, Vol. 16, No. 1, pp 3-4 (01/1967).  
Experiments are described in which nitrogen and neon lasers are  
excited by a wave of current excitation which effectively travels  
from one end of the laser to the other with its velocity matching  
that of the stimulated emission. This type of excitation is  
accomplished with a low-impedance flat-plate Blumlein pulse  
generator. The power output in the direction of the wave of  
excitation is at least ten times that in the other direction. A  
2.5-MHz pulse of about 4-nsec duration is obtained with nitrogen and a  
190-kV pulse of about 1.5 nsec with neon. 8 Refs.  
Primary Keywords: Blumlein Line; Solid Dielectric Switch; Travelling  
Wave; 4 ns Pulse Length  
Secondary Keywords: 1.1 MHz  
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7640  
(BREAKDOWN STUDIES)  
(Exploding Foils)  
CALCULATION OF HEATING AND BURST PHENOMENA IN ELECTRICALLY EXPLODED  
FOILS  
J.D. Logan, R.S. Lee, R.C. Meinert and K.S. Yee  
Lawrence Livermore Lab, Livermore, CA 94550  
Journal Of Applied Physics, Vol. 48, No. 2, pp 621-628 (02/1977).  
A method is presented for computing the transient current and  
temperature distributions in electrically exploded foils. The model  
employed is applicable up until the time of burst. Calculations are  
presented for Al, Cu, and Au foils showing good agreement with  
experimental burst times and burst currents over a wide range of  
capacitor-bank charging voltages and for varying foil cross sections.  
The two-dimensional nature of the calculation permits investigation  
of effects associated with nonuniform heating of the foil and gives  
an estimate of the simultaneity of burst. 33 Refs.  
Primary Keywords: Exploding Foils; Aluminum Foil; Copper Foil; Gold  
Foil; Current Calculation; Current Distribution;  
Temperature Distribution; Theory; Comparison With  
Experiment  
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7650  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
VACUUM BREAKDOWN OF A POINT-PLANE GAP IN HIGH VACUUM AND WITH  
VARIATION OF PRESSURE IN THE RANGE 1E-7 - 1E-2 TORR OF AIR, NITROGEN,  
HELIUM, SULPHUR HEXAFLUORIDE, AND ARGON  
R. Hackam and G.R. Govinda Raju  
University of Sheffield, Sheffield, UK  
Journal Of Applied Physics, Vol. 45, No. 1, pp 4784-4794 (11/1974).  
The DC breakdown potential of a point-plane electrode  
configuration is measured in high vacuum (approximately 1E-7 Torr)  
using the positive and the negative voltage polarity of the point  
electrode as a function of gap separation. Air, nitrogen, helium,  
sulphur hexafluoride, and argon are used in turn to alter the  
electrode coverage by adsorption of various gases in high vacuum. It  
has been found that helium gives the highest breakdown voltage at a  
given gap length, in high vacuum. It has also been found that very  
high working potential values are obtained using  
positive-point-negative-plane electrodes (90 kV at 0.3 mm gap length,  
helium at 1E-7 Torr). The effect of AC (50 Hz) glow discharge  
conditioning on the dielectric strength of the gap is investigated  
and found to give considerable improvement in the voltage that the  
gap can withstand before a vacuum breakdown occurs. The effect of  
introducing various gases in the pressure range 1E-7 - 1E-2 Torr on  
the breakdown potential of point-plane gaps is investigated. Maxima  
are observed in the breakdown voltage and pressure curves in the  
range of 1E-4 - 1E-3 Torr. Helium and nitrogen give the highest  
breakdown voltage of about 90 kV for a gap length of 0.2 mm at about  
1E-4 Torr. The observed improvements in the breakdown potential that  
the gap can withstand with certain gases are attributed to the  
increase in the work function of the combined metal-gas system. 74  
Refs.  
Primary Keywords: DC Breakdown; Gas Adsorption; Positive-point Gap  
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7658  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
EXPERIMENTAL STUDY OF THE PROPAGATION OF AN IONIZING WAVE IN A COAXIAL  
PLASMA GUN  
J.M. Wilcox, E. Pugh, A. Dattner and J. Eninger  
Royal Institute of Technology, Stockholm, Sweden  
The Physics Of Fluids, Vol. 7, No. 11 (Supplement), pp 551-556  
(11/1984).  
A coaxial plasma gun experiment is described. The gun has an  
azimuthal bias magnetic field, which is strong compared to the field  
from the discharge current. The discharge voltage is shown to depend  
linearly on the bias field, thus defining a velocity that is found to  
be almost independent of the pressure and the discharge current. This  
velocity is close to the 'critical velocity' which has been found in  
rotating-plasma experiments. The velocity of the current layer is  
also measured; it is always smaller than or equal to the critical  
velocity and it decreases with increasing pressure and decreasing  
magnetic field. 9 Refs.  
Primary Keywords: Plasma Gun; Ionizing Wave; Ionization;  
Magnetohydrodynamics; Bias Magnetic Field; Current  
Sheet; Critical Velocity  
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7665  
(BREAKDOWN STUDIES)  
(Surface Flashover)  
HIGH SPEED PHOTOGRAPHY OF SURFACE FLASHOVER IN VACUUM  
J. D. Cross  
University of Waterloo, Waterloo, Ontario, Canada  
IEEE Transactions On Electrical Insulation, Vol. EI-13, No. 3, pp 145-148 (06/1978).  
The method and results of high speed streak photography of surface flashover in vacuum are presented. It is shown that the bright phase of the flashover arc bridges at 12.5 mm gap in 0.15 ns. The streak records indicate that the flashover arc is preceded by an intense electron burst from the cathode-insulator junction. 7 Refs.  
Primary Keywords: Surface Flashover; Streak Photography; Bright Phase; Cathode-Insulator Junction; Electron Burst  
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7666  
(ENERGY STORAGE, MECHANICAL)  
(Rotating Machines)  
HOMOPOLAR GENERATOR EFFECT OF SUDDEN SHORT CIRCUIT  
A. K. Das Gupta  
Regional Engineering College, Rourkela, Orissa, India  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-87, No. 3, pp 655-659 (03/1968).  
The effect of a sudden short circuit on a homopolar generator is analyzed and the transient time constant is deduced. The effect of nonuniform air gap flux is considered. It is shown that the time constant of a machine with a very small air gap and thick cylinder is quite large, while the time constant of a thin cylinder machine with a larger air gap is small. 11 Refs.  
Primary Keywords: Homopolar Generator; Load Short Circuit; Air Gap; Cylinder Thickness; Machine Time Constant  
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7672  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
MAGNETIC CUTOFF IN HIGH-CURRENT DIODES  
J. M. Creedon  
Physic International Co., San Leandro, CA 94577  
Journal Of Applied Physics, Vol. 48, No. 3, pp 1070-1077 (03/1977).  
The process of magnetic cutoff in diodes is investigated for several geometrical configurations. Generalized coordinates are used to show that the cutoff mechanism has certain basic properties which are common to all of the configurations considered. Theoretical solutions for two different one-dimensional flow patterns are compared and shown to have similar mathematical properties. Measurements are compared to theory for several types of magnetic cutoff. 21 Refs.  
Primary Keywords: Field Emission Diode; Transmission Line; Magnetic Cutoff; Load-limited Cutoff; Theory; Numerical Calculation  
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7678  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
PRESSURE DISTRIBUTION IN THE STRUCTURE OF A PROPAGATING CURRENT SHEET  
T. M. York (1) and R. J. Jahn (2)  
(1) Pennsylvania State University, University Park, PA  
(2) Princeton University, Princeton, NJ  
The Physics Of Fluids, Vol. 13, No. 5, pp 1303-1309 (05/1970).  
The structure of the current sheet in a dynamic pinch in argon is studied with a specialized high speed piezoelectric pressure transducer capable of following profiles of axial and radial pressure within the discharge. Correlation of these data with electric and magnetic field profiles, luminosity, and voltage records, indicates three distinct zones within the sheet in sequence: regions of electron current conduction, mass accumulation with ion current conduction, and induced flow of unspent gas. Profiles of particle density, velocity, and temperature are evaluated on the basis of a simplified gas-kinetic model. The current sheet is found to entrain a large percentage of the gas encountered, and a momentum balance across the sheet is in approximate agreement with snowplow predictions, but the distributions of current and mass density differ categorically from conventional piston-shock wave models. 9 Refs.  
Primary Keywords: Z-pinch; Current Sheet; Plasma Temperature; Plasma Density; Pressure Measurement; Self-magnetic Field  
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7685  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
RESISTANCE AND ENTHALPY OF REFRACTORY EXPLODING WIRES  
M. M. Martynov, I. Kirikhodzhayev and V. I. Tsapkov  
Patrice Lumumba University of International Friendship, Moscow, USSR  
Soviet Physics-Technical Physics, Vol. 19, No. 11, pp 1458-1461 (05/1975).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 44, 2367-2373 (November 1974).  
A pulsed oscilloscope method has been used to measure the relative electrical resistance  $R$  divided by  $R_{sub}$  of a function of the enthalpy  $H$  for Zr, Hf, Nb, Mo, W, and Pt as the wire samples are heated by current pulses with  $t_{sub}$  3/2400-500 and 30-35 microseconds. In the prolonged heating the samples are ruptured immediately after melting; with a briefer heating, there is a deeper penetration into the liquid-state region, up to temperatures far above the normal boiling point of the metal. The values of  $R$  divided by  $R_{sub}$  of and  $H$  for the solid and liquid phases of these metals are measured at the boiling point and at the temperature corresponding to the beginning of the electrical explosion.  $R_{sub}$  3/2 in pulsed heating in water at  $t_{sub}$  3/20-35 microseconds, the values of  $R$  divided by  $R_{sub}$  of for Zr, Hf, Nb, and Mo remain essentially constant in the liquid-state region up to  $t_{sub}$  3/2. The temperature  $T_{sub}$  3/2 which is identified as being approximately equal to the critical temperature, is evaluated. In pulsed heating in air there is a dip in the value of  $R$  divided by  $R_{sub}$  of for the liquid state of all these metals; this behavior is attributed to discharge shunting the sample. 14 Refs.  
Primary Keywords: Exploding Wires; Several Wire Materials; Wire Resistance; Wire Enthalpy; Boiling Temperature  
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7692  
(BREAKDOWN STUDIES)  
(Liquid, Electrical)  
INVESTIGATION OF THE BREAKDOWN BY RECTANGULAR VOLTAGE PULSES OF A LIQUID IN AN INHOMOGENEOUS FIELD  
I. P. Kuzhakin  
Moscow Power Institute, Moscow, USSR  
Soviet Physics-Technical Physics, Vol. 11, No. 12, pp 1585-1589 (06/1967).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 36, 2125-2130 (December 1967).  
An investigation is made of the breakdown time of a liquid. For water with a conductivity of  $2.5E-4$  Ohm-cm  $-1/2$  cm/sup  $-1/2$  the breakdown time is determined by the duration of the preleader stage and the velocity of propagation of the leaders. The voltage-time characteristics of gaps 1 and 2 cm in length under the action of rectangular voltage waves with amplitudes of up to 100 kV are presented. Descriptions are given of the peculiarities of breakdown of various gaps at various voltages. An empirical formula is given for estimating the mean breakdown time of positive rod-plane gaps of length 1 to 30 cm. 7 Refs.  
Primary Keywords: Water Breakdown; Preleader Stage; Streamer Velocity; Rectangular Voltage Pulse; Rod-plane Gap; Formative Time Lag  
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7694  
(INSULATION, VACUUM)  
( )  
VACUUM INSULATION OF HIGH VOLTAGES UTILIZING DIELECTRIC COATED ELECTRODES  
L. Jedynak  
University of Wisconsin, Madison, WI  
Journal Of Applied Physics, Vol. 35, No. 6, pp 1727-1733 (06/1964).  
An experimental research program has demonstrated that the high-voltage performance of a vacuum gap can be improved by the simple expedient of coating the cathode surface with a suitable thin insulating film. Steady voltages ranging to 340 kV were obtained with 5-mm gaps composed of 15-cm-diam Kovar electrodes. Simultaneously the average gap currents were suppressed to the  $1E-8$  to  $1E-10$  A range. Further, it was shown that an insulating film on the anode can be severely detrimental to gap performance. Experiments were performed, at voltages up to 380 kV, involving 12 different film materials. Film thickness ranged from 0.2 to 135 micron and film resistivities ranged from  $1E11$  to  $1E19$  ohm-cm. The dielectric constants were between 1.7 and 3.5, except for one at 92. Based upon the experimental results and their interpretation, a tentative set of specifications can be given for a good cathode film: (1) resistivity of at least  $1E11$  ohm-cm; (2) dielectric constant in the range 1.5 to 4; (3) dielectric strength of at least  $1E6$  V/cm; (4) film thickness between 10 and 25 micron; (5) mechanically hard and smooth with high abrasion resistance and high adhesion strength (6) no gas bubbles within the film. If bubbles are unavoidable they must be substantially smaller than the film thickness; (7) low vapor pressure; (8) the cathode substrate should be of a highly polished metal suitable for quality deposition of the desired film material. 45 Refs.  
Primary Keywords: Vacuum Insulation; Electrode Surface Coating; Current Reduction; Several Film Materials; Variable Film Thickness; Design Criteria  
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7706  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
PULSED FIELD EMISSION CATHODE EMITTANCE MEASUREMENTS  
J. R. Uglium, S. E. Graybill and S. V. Nablo  
Ion Physics Corp., Burlington, MA 01803  
The Review Of Scientific Instruments, Vol. 40, No. 11, pp 1413-1414 (01/1969).  
A technique is described for the precise determination of the emittance diagrams for megacurrent electron beams at energies of up to 100 MeV/cm. Two megacurrent volt beams from both single point hemispherical stainless steel and planar graphite emitters were studied, and emittance figures of 6.4 and 10  $\pi$  mm-cm, respectively, were obtained for the central 1 mm diameter portion of the streams generated by each configuration. 5 Refs.  
Primary Keywords: Field Emission Diode; Emittance Measurement; MeV Hemispherical Stainless Steel Cathode; Plan Graphite Cathode  
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7726  
(ELECTROMAGNETIC LAUNCHERS)  
(Railguns)  
MAGPAC-A RAILGUN SIMULATION PROGRAM  
R. J. Dondrick, R. S. Hawke and J. K. Scudder  
Lawrence Livermore Lab., Livermore, CA 94550  
UCRL Report No. UCRL-84877 (10/1980).  
Availability: UCRL-84877  
NTIS  
We have developed and validated a computer simulation code at the Lawrence Livermore National Laboratory (LLNL) to predict the performance of a railgun-electromagnetic accelerator. The code, called MAGPAC (MAGnetic Railgun ACcelerator), models the performance of a railgun driven by a magnetic flux compression current generator (MFCG). The MAGPAC code employs a time-step solution of the nonlinear time-varying element railgun circuit to determine rail currents. From the rail currents, the projectile acceleration, velocity, and position is found. We have validated the MAGPAC code through a series of eight railgun tests conducted jointly with the Los Alamos Scientific National Laboratory. This paper describes the formulation of the MAGPAC railgun model and compares the predicted current waveforms with those obtained from full scale experiments. 8 Refs.  
Primary Keywords: Simulation; Numerical Calculation; MAGPAC; Flux Compression Generator; Rail Current; Projectile Acceleration; Velocity; Position

A. J. Palmer  
Hughes Research Labs, Malibu, CA 90265  
Applied Physics Letters, Vol. 25, No. 3, pp 138-140 (08/1974).  
A model on the preionization requirements for initiating a volume stabilized glow discharge is proposed. The basic requirement of the model is that the preionized electron density be large enough to cause appreciable spatial overlap of the primary avalanches and consequent smoothing of space-charge field gradients at the stage where streamer formation would otherwise occur. A minimum required preionized electron density of approximately  $1\text{E}4\text{ cm}^{-3}$  is predicted for a CO/sulfur hexafluoride (SA) gas mixture and is consistent with experimental observations. 11 Refs.  
Primary Keywords: Glow Discharge; Volume Stabilization; Preionization; Degree Of Preionization; Theory, Modeling  
Secondary Keywords: Gas Loss; Pumping  
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1. McManor  
2. Pont Co. Wilmington, DE 19888  
IEEE Transactions On Electrical Insulation. Vol. EI-13, No. 4, pp  
7-17, 1978  
Test methods for studying electric breakdown in solid dielectric  
materials through the mechanism of 'Treeing' are described. While  
this tutorial is directed to internally initiated breakdown, the same  
basic progressive failure occurs in surface initiated breakdown, but  
with different time lags. These are discussed briefly, not because  
it is unimportant, but because in most cases water trees can lead to  
the development of electrical trees which cause the ultimate failure  
10 Refs.  
Primary Keywords: Insulation Breakdown; Electrical Treeing; Volume  
Breakdown; Surface Discharge; Water Tree  
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Physical Review, Vol. 123, No. 2, 1962. The Townsend coefficients  $\alpha$  and  $\gamma$  for argon have been measured in uniform fields for low values of the ratio of field strength to pressure  $E/p$  5 to 12 V (cm mm Hg). Currents obtained with varying electrode separation  $d$  at constant  $E/p$  and constant  $\alpha$  could not be analyzed to yield values of the Townsend coefficients  $\alpha$  and  $\gamma$  and  $\gamma$  and  $\gamma$ . Currents obtained with varying  $p$  at constant  $E/p$  and constant  $d$  could be analyzed to yield values of  $\alpha$  and  $\gamma$  and  $\gamma$  and  $\gamma$ , but such currents were also contaminated by currents which depend on  $d$ . The dependence of the values of  $\alpha$  and  $\gamma$  on  $d$  is attributed to the production of highly excited atoms by resonance radiation at some distance from the positions where the electrons lose their energy; these highly excited atoms then produce molecular ions and electrons in a spark with ground-state argon atoms. The second Townsend coefficient and the dependence of  $\gamma$  on  $p$  could not be analyzed with resonance radiation. Sparking potential measurements in argon made by varying both  $p$  and  $d$  for values of  $p$  corresponding to breakdown for the above range of  $E/p$  show deviations from Paschen's law. 29 Refs.

Primary Keywords: Gas Breakdown; Argon Gas; Low  $E/p$ ; Uniform Field Breakdown; Prebreakdown Current; Variable Gas Pressure; Sparking; Variable Gas Pressure

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J.C. Devins, S.J. Rzed and R.J. Schwabe  
General Electric Co. Schenectady, NY 12301  
Journal Of Applied Physics, Vol. 52, No. 7, pp. 4351-4345 (07/1981).  
In this paper we present a comprehensive account of our results on streamer propagation in dielectric liquids. Streamer propagation is investigated both on positive and negative streamers. Propagation characteristics are determined as a function of the following parameters: temperature, pressure, density, viscosity, composition, and conductivity. Effects of voltage and interelectrode spacing were examined. Current and light emission measurements were made. The relation between shock wave and streamer propagation is measured. The relation between streamer propagation and electrical breakdown is investigated. It is found that the acceleration of positive streamers, while electric field is applied, is much smaller than the acceleration of negative streamers. Mechanisms to account for these observations are discussed. 36 Refs.  
Primary Keyword: Liquid Breakdown; Prebreakdown Current; Point-plane  
Secondary Keyword: Gas; Optical Diagnostic; Streamer Propagation  
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N. H. Malik and A. M. Qureshi,  
University of Windsor, Windsor, Ontario, Canada  
IEEE Transactions On Electrical Insulation, Vol. EI-13, No. 3, pp  
135-144 (1978).

The well-known breakdown theories, Townsend's generation mechanism and the streamer mechanism, are reviewed and applied to the results of the breakdown in the strongly electronegative gas, sulphur hexafluoride. Experimental results obtained in the literature on the breakdown behavior of sulphur hexafluoride are examined in the light of these theories. The breakdown theories are used for the explanation of the breakdown voltages in pure SF<sub>6</sub>/sub 6/. Other factors that may affect the breakdown characteristics of SF<sub>6</sub>/sub 6/ have been discussed. Further areas of work have been proposed in order to obtain a better understanding of the breakdown mechanism. 76 Refs.

Primary Keywords: SF<sub>6</sub> 6/ Breakdown; Breakdown Mechanism; Avalanche Streamer; Breakdown Voltage Prediction

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70619179.  
A simple method based on the streamer criterion is proposed to calculate the discharge inception voltages in SF<sub>6</sub>/sub 6/-N/sub 2/ mixtures with SF<sub>6</sub>/sub 6/ content between 1 and 100%. It is shown that the calculated values are in good agreement with experimental measurements. The gas mixtures having varying degrees of field non-uniformities. 17 refs.

Primary Keywords: Gas Breakdown; Nitrogen Gas; SF<sub>6</sub>/sub 6/ Gas; Theory; Streamer Criterion; Breakdown Voltage Calculation; Monuniform Field

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Decomposition products from sparked 2-C/sub 6/ 4-F/sub 6/ sub (2-perfluorobutynyl)-SF/sub 6/ mixtures have been identified. These include the perfluorocarbons, CF/sub 4/ sub, C/sub 2/ F/sub 4/ sub, C/sub 2/ F/sub 6/ sub, C/sub 3/ F/sub 8/ sub, C/sub 3/ F/sub 10/ sub, C/sub 4/ sub F/sub 12/ sub, and C/sub 4/ sub F/sub 14/ sub, and two isomers of S/sub 2/ C/sub 2/ F/sub 4/ sub. Saturated perfluorocarbon products are shown to increase in abundance with increasing concentration of SF/sub 6/ in 2-C/sub 6/ 4-F/sub 6/ up to approximately 70% SF/sub 6/ in 2-C/sub 6/ sub. At higher concentrations, the abundant decomposition products are present in smaller amounts than in the 70% SF/sub 6/ in 2-C/sub 6/ sub mixture. Varying concentrations of SF/sub 6/ in measured quantities of 2-C/sub 6/ 4-F/sub 6/ sub have been found to show a maximum for the (70%) SF/sub 6/ in 2-C/sub 6/ 4-F/sub 6/ sub composition. The data suggest that the suppression of solid carbon deposits is affected by conversion of carbon to gaseous products (mostly SF/sub 6/ sub, perfluorocarbons). Comparisons are made with the evidence of carbon inhibition. These results indicate that proper tailoring of SF/sub 6/ 6-perfluorocarbon mixtures can effectively inhibit carbon formation. 1 Refs.

Primary Keywords: Gas Discharge; Decomposition Products; Perfluorocarbon-SF/sub 6/ Mixtures; Carbon Deposits; Deposit Inhibition

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7746  
(PARTICLE BEAMS, ELECTRON; PULSE GENERATORS)  
(Generation; Pulse forming lines)  
CHARGED, INTERNALLY SWITCHED TRANSMISSION LINE CONFIGURATIONS FOR  
ELECTRON ACCELERATION  
D. Eccleshall, J.K. Tampoyle and C.E. Hollandsworth  
Armadament Research and Development Command, Aberdeen Proving Ground,  
MD 21005  
IEEE Transactions On Nuclear Science, Vol. NS-26, No. 3, pp 4245-4247  
106, 1979).

High current pulsed electron beams may be accelerated with  
nominally 100% efficiency using induction accelerators based on  
lines of charged internally-switched constant-impedance transmission  
stages. Under certain conditions one obtains a repeating open circuit  
voltage waveform which can, in principle, be used to transfer 100% of  
stored energy to a beam which is recirculated and this would permit  
higher overall acceleration gradients. We have also identified some  
of the most efficient line arrangements which could be exploited in the  
simplest case mode. Some of the fundamental practical limitations to  
these concepts, such as the pulse distortion at line discontinuities  
and coupling to the beam, have been studied at the Refs.  
Primary Keywords: Electron Acceleration; Line Pulse; Closing Switch;  
High Transfer Efficiency; Pulse Distortion; Theory

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Partial discharge phenomena appear to play an important role in insulation failures, and thus the analysis of products resulting from such degradation should lead to an understanding of insulation breakdown mechanisms and more accurate determination of insulation lifetimes. Progress in the area of degradation product analysis is reviewed for solid and liquid insulating materials. 107 Refs.

Primary Keywords: Insulation Aging; Insulation Failure; Insulation Lifetime Calculation

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1. G. Cherenkov, D.R. Ames and R. M. S. Thomsen, Oak Ridge National Lab., Oak Ridge, TN 37830  
Journal of Physics D: Applied Physics, Vol. 14, No. 4, pp 675-692 (1981).

Dielectric gas mixtures comprising mainly one electron-attaching component and one dipolar component have been investigated. It has been found that polar electron-slowing-down components effect a sharp increase in the breakdown voltage,  $V_{sub} \propto \sqrt{\epsilon}$ , with small percentages of electron-attaching additives. The effect of electron-dipole scattering on  $V_{sub} \propto \sqrt{\epsilon}$  for multicomponent dielectric mixtures is assessed, especially in connection with indirect electron scattering associated with a negative ion states. The results demonstrate further the beneficial effect of large electron scattering cross-sections at subexcitation energies on  $V_{sub} \propto \sqrt{\epsilon}$  and suggest that a careful combination of gases, slowing-down and electron-attaching, and electron scattering, will effect large  $V_{sub} \propto \sqrt{\epsilon}$  values. This and earlier studies suggest that a number of dielectric gas mixtures containing one or two electron-attaching components from  $c-C_4H_8$  ( $V_{sub} \propto \sqrt{\epsilon}$ , 2- $C_4H_8$  ( $V_{sub} \propto \sqrt{\epsilon}$ , 5- $C_4H_8$  ( $V_{sub} \propto \sqrt{\epsilon}$ , 2- $C_4H_8$  ( $V_{sub} \propto \sqrt{\epsilon}$ , 3- $C_4H_8$  ( $V_{sub} \propto \sqrt{\epsilon}$ , 4- $C_4H_8$  ( $V_{sub} \propto \sqrt{\epsilon}$ , 5- $C_4H_8$  ( $V_{sub} \propto \sqrt{\epsilon}$ , 6- $C_4H_8$  ( $V_{sub} \propto \sqrt{\epsilon}$ , 7- $C_4H_8$  ( $V_{sub} \propto \sqrt{\epsilon}$ , 8- $C_4H_8$  ( $V_{sub} \propto \sqrt{\epsilon}$ , 9- $C_4H_8$  ( $V_{sub} \propto \sqrt{\epsilon}$ , 10- $C_4H_8$  ( $V_{sub} \propto \sqrt{\epsilon}$ , 11- $C_4H_8$  ( $V_{sub} \propto \sqrt{\epsilon}$ , 12- $C_4H_8$  ( $V_{sub} \propto \sqrt{\epsilon}$ , 13- $C_4H_8$  ( $V_{sub} \propto \sqrt{\epsilon}$ , 14- $C_4H_8$  ( $V_{sub} \propto \sqrt{\epsilon}$ , 15- $C_4H_8$  ( $V_{sub} \propto 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7751  
(INSULATION, MATERIAL; BREAKDOWN STUDIES)  
(Solid; Gas, Electrical)

#### DISCHARGES

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Polytechnic Of The South Bank Borough Road, London, UK  
IEEE Transactions On Electrical Insulation, Vol. EI-13, No. 4, pp  
C11-238 (08/1978).

The electric strength of solid insulation may decrease greatly with time of voltage application if discharges occur within gaseous inclusions, at sheared conductors embedded in the solid, on the surface from adjacent conductors, or as a result of surface contamination. Mechanisms of breakdown and factors which affect the electric strength of gases are surveyed, as a basis for understanding the complex behavior of internal and surface discharges; particularly temporal changes in their magnitude and occurrence frequency. Mechanisms by which discharges cause progressive degradation and ultimate failure are considered, also techniques for assessing the relative resistance of materials to surface or internal discharges of "freeing". Finally the review surveys the merits of different methods for ensuring against failure by discharges. Reliance on short-term over-voltage tests reduces the cost of testing but there is considerable risk of trees or tracking being initiated, rendering the insulation more likely to fail in service. Discharge measurements reduce this risk, but it is important to discriminate between discharges in the test object and external interference. There is as yet inadequate information for specifying acceptable discharge levels for the many types of insulation and service conditions. 161 Refs.

Primary Keywords: Solid Insulation; Insulation Dielectric Strength; Inclusion; Conductor Edge; Effect Of Voltage Duration; Insulation Testing

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7752  
(INSULATION, MATERIAL)  
(Liquid)

EFFECT OF DISSOLVED GASES, ORGANIC ADDITIVES AND FIELD CONFIGURATION ON CO-FIELD MOTION IN INSULATING OILS

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(1) College Of Engineering, Riyadh, Saudi Arabia  
(2) University Of Alexandria, Alexandria, Egypt  
IEEE Transactions On Electrical Insulation, Vol. EI-14, No. 1, pp 21-27 (02/1979).

The effect of dissolved gases ( $O_2$  sub 2/, air and  $N_2$  sub 2/) and a wide range of concentration of organic additives (quinoline, toluene and naphthalene) on the electrohydrodynamic head due to co-field motion in transformer oil and liquid paraffin has been measured for both uniform and nonuniform fields using direct voltages. The effect of gap length on the head was also examined. The results indicate that all the dissolved gases investigated as well as toluene and naphthalene reduced the developed head, whereas quinoline increased the head. With a highly nonuniform field the effect of  $O_2$  sub 2/ and toluene was found to be strongly dependent on the polarity of the point electrode. 10 Refs.

Primary Keywords: Liquid Insulation; Transformer Oil; Dissolved Gas; Oxygen; Air; Nitrogen; Organic Additive; Quinoline; Toluene; Naphthalene; Co-field Induced Motion

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7753  
(INSULATION, MATERIAL)  
(Solid)

ELECTRIC FIELDS AND SECONDARY EMISSION NEAR A DIELECTRIC-METAL INTERFACE  
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Pennsylvania State University, University Park, PA  
IEEE Transactions On Electrical Insulation, Vol. EI-14, No. 1, pp 14-20 (02/1979).

Dielectric surface charge distributions near a metal dielectric interface in vacuum depend upon secondary emission processes in the presence of normal and tangential components of electric fields. From measured charge distributions created by exposing a specimen of fluorinated ethylene-propylene to monoenergetic electron fluxes, it has been possible to calculate potentials and fields on and near the dielectric surface. The effect of normal electric field upon secondary emission is measured directly and the effect of the tangential field is inferred from the charge distribution data. The critical point (unity crossover) for secondary emission is shifted by the application of fields so that it occurs at much higher primary energies than normally. Primary beams having energies up to 20 keV are used and surface fields are as high as 20 kV/mm. 14 Refs.

Primary Keywords: Solid Insulation; Surface Charging; Dielectric-Electrode Interface; Secondary Emission; Vacuum Environment

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7756  
(BREAKDOWN STUDIES)  
(Gas; Recovery)

#### ELECTRON ATTACHMENT TO SF<sub>6</sub> SUB 6/

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Aeronomy Lab, ESSA Research Labs, Boulder, CO 80302  
The Journal Of Chemical Physics, Vol. 53, No. 5, pp 2000-2004 (09/1970).  
The attachment rate for electrons to SF<sub>6</sub> sub 6/ has been measured between 293 and 1.5 Deg K in a helium-buffered flowing afterglow over the pressure range of 0.1-1.5 Torr. The attachment has a rate constant of  $2.2 \times 10^{-7}$  cm<sup>3</sup>/sec, independent of temperature and pressure. The primary reaction product over the measured range of temperatures is SF<sub>6</sub> sub 6/ sup -. However, the rate of production of SF<sub>6</sub> sub 6/ sup - increases rapidly with temperature. 17 Refs.

Primary Keywords: SF<sub>6</sub> sub 6/ gas; Attachment Rate Measurement; 293-523 Deg K; Temperature Range; 0.1-1.5 Torr Pressure Range; Constant Rate

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7757  
(BREAKDOWN STUDIES)  
(Gas; Electrical)

ELECTRON-PPICS STUDY OF THE DEVELOPMENT OF AN ELECTRIC DISCHARGE IN A GAS AT HIGH-ELECTRIC FIELD INTENSITIES AND WITH ONE-ELECTRON IGNITION  
L.G. Bychkova, N.I. Bychkov, G.A. Movsatov and Ya.Ya. Yurike  
Tomsk Polytechnic Institute, Tomsk, USSR  
Soviet Physics Journal, Vol. 12, No. 11, pp 1389-1391 (11/1969).  
Trans. From: Izvestiya Vysshikh Uchebnykh Zavedeniy: Fizika 12, 24-27 (November 1969).

A study was made of the luminous region in a discharge gap with copper electrodes, a field of  $E \approx 80$  kV/cm, air at atmospheric pressure, and a gap width of 4 or 2 mm. The cathode was irradiated with a spark to ignite the initial electrons. The electron current from the cathode was 0.2F9 electrons/sec. The exposure time per frame was 31-9 sec. With a gap width of delta=4 mm, a luminous region is observed at the cathode 2 nsec after voltage is applied to the gap; this region propagates toward the anode, simultaneously increasing in diameter, at a velocity of approximately 1E3 cm/sec. A voltage drop is established across the gap approximately 0.5 nsec after the luminous front arrives at the cathode. In narrower gaps, the voltage drop is established across the gap a considerable time after the luminous region has crossed the gap. 9 Refs.

Primary Keywords: Spark Discharge; Copper Electrodes; Air Gas; Atmospheric Pressure; Channel Luminosity; Photographic Diagnostic; Voltage Measurement; Correlation

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7759  
(PARTICLE BEAMS, ION; PARTICLE BEAMS, ION)  
(Generation; Transport)

#### EXTRACTION AND FOCUSING OF INTENSE ION BEAMS FROM A MAGNETICALLY INSULATED DIODE

S. Humphries Jr., R.N. Sudan and L. Wiley  
Cornell University, Ithaca, NY 14850  
Journal Of Applied Physics, Vol. 47, No. 6, pp 2382-2390 (06/1978).

A magnetically insulated diode has been used to produce cylindrically converging, intense proton beams. By providing electron neutralization along field lines, the beams can be propagated across the magnetic field to a distance of 1 cm of the axis. Proton currents up to 5 A have been propagated to achieve current densities up to  $70$  A/cm<sup>2</sup>. Divergences less than 3 mrad have been achieved with new plasma anode designs. Calculations are presented on the extrapolation of magnetic diodes to achieve power densities needed for ion-beam pellet fusion breakdown. 15 Refs.

Primary Keywords: Ion-beam Generation; Field Emission Diode; Plasma Anode; Solid Cathode; Magnetic Insulation; Self-focusing Beam

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7761  
(BREAKDOWN STUDIES)  
(Gas; Electrical)

#### GROWTH OF THE SPARK DISCHARGE CANAL FOR A DISCHARGE CIRCUIT WITH A RAPIDLY INCREASING CURRENT

I. Andreev, M.P. Vanyukov and A.B. Kotolov  
Soviet Physics-Technical Physics, Vol. 7, No. 1, pp 37-40 (07/1962).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 32, 57-62 (January 1962).

Using apparatus with a 1E-9 sec (nanosecond) solution time we studied the development of the spark discharge canal in air for the case of a discharge circuit with a rapidly increasing current. We compared our results with the results calculated by means of Drabkin's and Braginskii's theories. We registered, experimentally, canal widening rates of 10-12 km/sec. 11 Refs.

Primary Keywords: Gas Discharge; Spark Channel; 1E12 A/sec Current

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7762  
(BREAKDOWN STUDIES)  
(Gas; Electrical)

#### HIGH CURRENT SPARK CHANNELS

J.E. Allen and J.D. Drages  
University Of Liverpool, Liverpool, UK  
British Journal Of Applied Physics, Vol. 5, pp 446-453 (12/1954).

Mean currents have been made on high current (up to 265 kA) spark channels in air, argon and hydrogen. The voltage gradients existing in the channels were determined by oscillographic measurements and were found to increase with increasing current in the range studied. Power inputs of  $10^4$  J megawatts per centimetre length of channel were dissipated in the measured voltage gradients. Rotating-mirror photographs of the discharges were taken, using a camera with a resolution better than 1/5 of a micron. The photographs obtained show a number of interesting features which are peculiar to these high current discharges, the chief one being the bright central core of the discharge, which was photographed in every case. Temperatures of about 1E5 Deg K were estimated from electron mobility considerations. The central core of the discharge appears to be due to the self-magnetic 'pinch' effect, and calculations based on this inference suggest that high ion densities (approximately 1E19 per cu cm) exist in the centre of the core; the energy requirements for such conditions are compatible with the measured power inputs. 29 Refs.

Primary Keywords: Spark Channel; Air Breakdown; Argon Breakdown; Hydrogen Breakdown; Voltage Measurement; Current Measurement; Temperature Measurement; 265 kA Current

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7765  
(SWITCHES, CLOSING)  
(Vacuum Gaps; Electrical)

#### HIGH-POWER VACUUM SPARK GAP

D.C. Hagerman and A.H. Williams  
Los Alamos National Labs, Los Alamos, NM 87545  
The Review Of Scientific Instruments, Vol. 30, No. 3, pp 182-183 (03/1959).

The design and construction of a voltage graded vacuum spark gap is described. The gap is capable of switching currents as large as 1E6 amp at voltages up to 75 kV. The effect of the insulating walls of the gap is briefly discussed. 2 Refs.

Primary Keywords: Vacuum Spark Gap; Voltage Grading; Insulation Effects; 75 kV Operating Voltage; 1 MA Switch Current

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7766

(BREAKDOWN STUDIES; BREAKDOWN STUDIES)

(Gas, Electrical; Electrodes)

HIGH-TEMPERATURE EFFECTS ON FLASHOVER IN AIR

L. E. Alston

A. Rayrolle &amp; Co. Ltd., Habburn, County Durham, UK

Proceedings of The IEE, Vol. 105, Part A, No. 24, pp 549-553 (12/1958).

The authors report a study of electrode temperature effects on gas breakdown. Experiments were conducted with hot spots to 1200 Deg.C. These hot spots were found to lower the breakdown voltage. Gases durable in uniform-field gaps but had lesser effect in the low-field regions of nonuniform-field gaps. This effect is used to explain the triggering mechanism of triatron gaps. 6 Refs.

Primary Keywords: Gas Breakdown; Electrode Effects; Electrode Hot Spot; Gas Heating; Breakdown Voltage Reduction; Triatron Operation; Circuit Breaker Operation

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7767

(SWITCHES; CLOSING)

(Gas Gaps; Electrical)

HIGH-VOLTAGE, LOW-INDUCTANCE SWITCH FOR MEGAMPERE PULSE CURRENTS

W. R. Baker

Lawrence Berkeley Lab., Berkeley CA

The Review of Scientific Instruments, Vol. 30, No. 8, pp 700-702

(08/1959)

A switch is described that will handle pulse currents of several milliamperes and stand off DC supply voltages of over thirty kilovolts. It is useful in powering fast pinch devices such as those used in thermonuclear research. 5 Refs.

Primary Keywords: Low Pressure Gas Switch; Low Inductance; High Reliability; Long Switch Life; Plasma Baffle; Fringe Dielectric

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7769

(INSULATION, MATERIAL; BREAKDOWN STUDIES)

(Solid; Surface Flashover)

LIGHTENING FIGURES ON VARIOUS ELECTRICAL INSULATING MATERIALS

A. Kawashima and S. Moh

College of Technology, Seikai University, Tokyo, Japan

IEEE Transactions On Electrical Insulation, Vol. EI-13, No. 1, pp 51-56

(02/1978)

The surface discharge on insulating solid materials was recorded by a camera with high speed films. This simple method was found to be useful for the investigation of the surface discharge on various insulating materials. Lightning figures on the surface of solid insulating materials were determined by this method. The starting voltage for the formation of lightning figures was found to depend on the surface resistance of the insulating material, while the rate of the development of surface discharge with the applied voltage depends on the relative permittivity of the insulating materials. It is expected that the dielectric strength of an insulating material can be improved by covering its surface with highly resistive materials. 5 Refs.

Primary Keywords: Lightning Figure; Surface Flashover; Photographic Diagnostic; Flashover Voltage; Surface Resistance; Insulator Permittivity

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7771

(PARTICLE BEAMS, ION; INSULATION, MAGNETIC)

(Generation)

MICROSECOND-PULSE INSULATION AND INTENSE ION BEAM GENERATION IN A

MAGNETICALLY INSULATED VACUUM DIODE

S. C. Luckhardt and M. H. Fleischmann

Cornell University, Ithaca, NY 14850

Applied Physics Letters, Vol. 30, No. 4, pp 182-185 (02/1977).

The insulation and ion generation characteristics of conical magnetically insulated diodes were tested using microsecond voltage pulses from a Marx generator with magnetic fields ranging up to 20 kG. Voltages of 150-300 kV and gap widths of 0.3-2.9 cm. Voltage standoff was observed for up to 4 microseconds when using graphite or metallic electrodes. With plasma-producing tungsten filament anodes high-energy ion beam pulse lengths of up to 1.5 microseconds and initial charge generation densities of up to 1.5 microC/cm<sup>2</sup> were obtained. 16 Refs.

Primary Keywords: Vacuum Diode; Ion Beam Generation; Microsecond Pulse Lengths; Marx Generator; Graphite Electrodes; Tungsten Electrodes

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7773

(BREAKDOWN STUDIES)

(Gas; Dielectric)

ON THE ROLE OF THE ELECTRON IMPACT IONISATION AND ELECTRON SCATTERING

CROSS-SECTION IN THE BREAKDOWN STRENGTH OF DIELECTRIC GASES

L. G. Christofilos, D. R. James and R. A. Mathis

Oak Ridge National Lab., Oak Ridge, TN 37816

Journal of Applied Physics, Vol. 42, No. 8, pp 1223-1236

(08/1978)

In this paper we discuss the role of the electron impact ionization cross-section  $\sigma_{\text{ion}}/\text{cm}^2$  (ionization) and the electron scattering cross-section  $\sigma_{\text{sc}}/\text{cm}^2$  (scattering) as a function of electron energy in the breakdown strength of gas mixtures. Four gases (Ne, Ar, N<sub>2</sub>, and SF<sub>6</sub>) were chosen for which  $\sigma_{\text{ion}}/\text{cm}^2$  (ionization) and  $\sigma_{\text{sc}}/\text{cm}^2$  (scattering) at low energies are known. Direct-current breakdown strength measurements on Ne, Ar, N<sub>2</sub>, and SF<sub>6</sub> (Ar + SF<sub>6</sub>, N<sub>2</sub> + SF<sub>6</sub>, and N<sub>2</sub> + Ar + SF<sub>6</sub>) were made and are reported. Using sphere-to-sphere to sphere-to-plane and plane-to-plane electrode geometries. On the basis of these measurements and the data on  $\sigma_{\text{ion}}/\text{cm}^2$  (ionization) and  $\sigma_{\text{sc}}/\text{cm}^2$  (scattering) it was concluded that the magnitude of  $\sigma_{\text{ion}}/\text{cm}^2$  (ionization) at subionization energies (1) and especially at subionization energies of liquid excited electronic state energies is much more significant in affecting a high dielectric strength than is  $\sigma_{\text{sc}}/\text{cm}^2$  (scattering). The effect of perfluorination and static polarizability on  $\sigma_{\text{ion}}/\text{cm}^2$  (ionization) is also discussed. 28 Refs.

Primary Keywords: Gas Breakdown; Electron Impact; Electron Scattering; Ionization Cross Section; Sphere-to-Sphere Gap; Sphere-to-Plane Gap; Plane-to-Plane Gap; Ne, Ar, N<sub>2</sub>, SF<sub>6</sub>; Gas; Hydrogen Gas; SF<sub>6</sub> Sub 6/ Gas

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7775

(PARTICLE BEAMS, ION; INSULATION, MAGNETIC)

(Generation)

PRODUCTION OF INTENSE PROTON FLUXES IN A MAGNETICALLY INSULATED DIODE

P. Dreike, C. Eichenberger, S. H. Humphries and R. Sudan

Cornell University, Ithaca, NY 14850

Journal of Applied Physics, Vol. 47, No. 1, pp 85-87 (01/1976).

A magnetically insulated diode has been used to produce intense fluxes of protons with high efficiency. Currents in excess of 4 kA with current density greater than 50 A/cm<sup>2</sup> have been produced in a 10-ns burst at energies up to 200 keV. The system appears to be easily scalable to higher parameters. The extraction of the beams, as well as geometries in which current densities of kA/cm<sup>2</sup> may be realized, are discussed. 8 Refs.

Primary Keywords: Ion Beam Generation; Magnetically Insulated Diode; 200 keV Beam Energy; 4 kA Beam Current; 50 ns Pulse Length

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7776

(BREAKDOWN STUDIES; INSULATION, MATERIAL)

(Liquid; Electrical; Liquid)

PROGRESS IN THE FIELD OF ELECTRIC BREAKDOWN IN DIELECTRIC LIQUIDS

A. K. Sreenivasan, C. Deane and S. J. Read

General Electric Co., Schenectady, NY 12301

IEEE Transactions On Electrical Insulation, Vol. EI-13, No. 4, pp

249-270 (07/1978)

For some fifty years the mechanism of electric breakdown in liquid insulation has been a subject of great interest for both theoretical as well as practical reasons. Over the years a number of promising hypotheses of breakdown have been advanced and it has been necessary to modify, and sometimes reject, interpretations of the breakdown data as additional experimental evidence has been accumulated. In this report we shall first examine some of the difficulties which are encountered in the measurement and interpretation of breakdown phenomena in the liquid state. Comparisons and generalizations with breakdown in gases and solids will be made, wherever possible. The concept of the "intrinsic strength" of a liquid will be discussed, as well as the development of the very important experimental techniques which have been used in conduction and breakdown studies. 122 Refs.

Primary Keywords: Liquid Breakdown; Dielectric; Comparison With Gas Breakdown; "Intrinsic" Dielectric Strength; Thermal Runaway

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7779

(SWITCHES; CLOSING)

(Vacuum Gaps; Electrical)

SOME PROPERTIES OF A GRADED VACUUM SPARK GAP

J. W. Mather and A. H. Williams

Los Alamos National Labs., Los Alamos, NM 87545

The Review of Scientific Instruments, Vol. 31, No. 3, pp 297-303

(03/1960)

A high power, low inductance vacuum spark gap combination (crowbar and main switch) is described which is capable of DC operations over a wide voltage range. The electrical properties are discussed in regard to shunting and multiple switch operation. The principal difficulty of vacuum spark gaps, the coating of the inner surface of the insulator with evaporated and sputtered electrode material, is absent in this design after conditioning. A mechanism to account for this, based on the establishment of a large number of nucleation centers on the insulating walls, is shown to be consistent with observation. 15 Refs.

Primary Keywords: Vacuum Spark Gap; Crowbar Switch; Starting Switch; High Power; Low Inductance; Insulation Conditioning; Metal Vapor Absorption

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7780

(INSULATION, MATERIAL)

(Composite)

PROPERTIES OF SOLID-LIQUID COMPOSITE DIELECTRIC SYSTEMS

Part 1

Critical Research Association, Leatherhead, Surrey, UK

IEEE Transactions On Electrical Insulation, Vol. EI-13, No. 4, pp

289-307 (07/1978)

The phenomenological aspects of the electrical properties of solid-liquid dielectrics are discussed with special relevance to the utilization of such systems at high electric stresses. The mechanisms of conduction, dielectric loss and breakdown in the solid-liquid system have been related to the performance of the solid-liquid system as a whole. The effects of solid dielectric structure and thickness have been developed and associated with possible breakdown processes for the impregnated dielectric in practical situations. The use of plastic films, with or without impurities, in impregnated capacitors is treated at some length as a useful device for developing the criteria which are important in all highly stressed solid-liquid systems. Considerable attention is given to aging phenomena and the way in which they may lead to various forms of failure in impregnated systems. Comprehensive data are provided from a summary of the literature relating to effects of temperature and electric stress applied singly and in combination. The effects of life-prolonging additives have been discussed briefly. 64 Refs.

Primary Keywords: Solid-Liquid Composite Insulation; High Insulation Stress; Losses; Insulation Breakdown; Plastic Film Insulation

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7783  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
STATIC FIELD BREAKDOWN OF SF/SUB 6/-N/SUB 2/ MIXTURES IN ROD-PLANE GAPS  
M. M. Patel, A. M. Ghosh, and G. D. Theophilus  
University of Windsor, Windsor, Ontario, Canada  
IEEE Transactions On Electrical Insulation, Vol. EI-14, No. 2, pp 61-69  
(04/1979)

The static field breakdown and corona characteristics of SF/sub 6/-N/sub 2/ mixtures in non-uniform field gaps for applied voltages of positive and negative polarities are discussed. Mixtures containing 0 to 100% SF/sub 6/ are studied over a pressure range of 100 to 500 kPa. The results show that for such gaps, the dielectric behavior of SF/sub 6/-N/sub 2/ mixtures is very similar to that of pure SF/sub 6/. A discontinuity is reported in the breakdown voltage-pressure characteristics of SF/sub 6/ and SF/sub 6/-N/sub 2/ mixtures when the rod electrode is positive. The pressure at which this discontinuity is observed is higher for the mixtures than for pure SF/sub 6/ and is affected by the mixture ratio. The breakdown voltage for certain mixtures is up to 70% higher than that of pure SF/sub 6/ when the rod electrode is negative. Breakdown strength of N/sub 2/ is very sensitive to the presence of small amounts of SF/sub 6/ and is almost doubled if 0.2% of SF/sub 6/ is added to N/sub 2/. The breakdown and corona characteristics are discussed in detail. 23 Refs.

Primary Keywords: Gas Breakdown; Nitrogen Gas; SF/sub 6/ Gas; Gas Mixture; Rod-plane Gap; Both Polarities; Breakdown Discontinuity; 100-500 kPa Pressure Range  
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7785  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
THE CHANNEL OF THE SPARK DISCHARGE  
J. M. Flowers

General Electric Co. Pittsfield, MA 01201  
Physical Review, Vol. 64, Nos. 7 and 8, pp 225-235 (10/1953).  
The luminous channel of the spark discharge and the discharge current are simultaneously measured. It is concluded that the spark discharge in air attempts to establish a channel in which the current density is a constant value of the order of 10<sup>10</sup> amperes/sq cm. During the formation of the channel, which takes place by an expansion process producing a pressure or sound wave, the current density is much greater. Throughout most of the formation time and the subsequent history of the channel, the light energy which is radiated is proportional mainly to the current within the channel. From potential measurements and the photographic records, the energy requirements for development are considered, and some possible relations of these requirements to the electrical circuits are discussed. The data are also discussed in relation to the progression of streamer. The pilot streamer theory of the lightning discharge is indicated to be unsatisfactory by comparison with measured discharge characteristics and the associated roles assumed for diffusion and recombination processes in the spark discharge channel do not appear valid. 23 Refs.

Primary Keywords: Spark Discharge; Radiation Measurement; Current Measurement; Air Breakdown; Pressure Wave; Streamer  
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7788  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES)  
(Electrodes; Vacuum; Electrical)  
THE INFLUENCE OF SOLID-STATE COHESION OF CONDITIONED METAL ELECTRODES ON THE ELECTRICAL STRENGTH OF THE VACUUM GAP  
A. K. Vish

Hydro-Quebec Institute of Research, Varannes, Quebec, Canada  
IEEE Transactions On Electrical Insulation, Vol. EI-11, No. 4, pp 160-162 (12/1976)

The solid-state cohesion of metals maintaining electrical stress across a vacuum gap appears to determine the magnitude of the electric strength of the vacuum gap. For conditioned electrodes (presumably free of adsorbed and wide layers) under direct-voltage conditions, higher electric strengths are associated with metals having high metal-metal bond energies and vice versa. 7 Refs.

Primary Keywords: Vacuum Breakdown; Electrode Effects; Solid State Cohesion; Microparticles; Electrode Conditioning  
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7789  
(SWITCHES, OPENING)  
(Mechanical)  
THE NATURE OF METAL-ELECTRODES/SF/SUB 6/ REACTIONS IN SF/SUB 6/ DECOMPOSITION DUE TO DIRECT-CURRENT INTERRUPTION UNDER SIMULATED CIRCUIT-BREAKER CONDITIONS  
A. K. Vish

Hydro-Quebec Institute of Research, Varannes, Quebec, Canada  
IEEE Transactions On Electrical Insulation, Vol. EI-11, No. 4, pp 157-163 (12/1976)

The nature of metal/SF/sub 6/ reactions under direct-current (DC) simulated circuit-breaker conditions has been examined in order to explore: 1) the identity of the processes responsible for the different magnitudes of electrode consumption for various pure metals; 2) the factors determining the different rates of reaction with SF/sub 6/ obtained for different metals. It is concluded that high-current arc erosion, which would be expected to consume the metal in the absence of SF/sub 6/, is also the primary mode of weight loss of electrodes in the presence of SF/sub 6/. The rates of reaction of the evaporated metals seem to be related to their tendencies to attack SF/sub 6/ at the sulphur 'site' and not, as is generally assumed, at the fluorine 'sites'. Rather good correlations are observed between the reaction rates and the heats of formation per equivalent for metal sulphides or the electrode potentials for metal/metal sulphide electrodes. 5 Refs.

Primary Keywords: DC Circuit Breaker; Gas Electrode Reaction; SF/sub 6/ Gas; Electrode Erosion  
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7791  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
THEORY OF THE DEVELOPMENT OF A SPARK CHANNEL  
S. I. Braginskii

Soviet Physics JETP, Volume 7, No. 6, pp 1068-1074 (12/1958).  
Trans. From: Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki 34, 1548-1557 (June 1958)

The principle processes taking place in a spark channel at moderate currents are examined. Solutions are obtained for the motion of the gas outside the channel. A new type of hydrodynamic jump is considered, a strong discontinuity with external supply of heat. Certain solutions are found which describe the state of the gas inside the channel, and expressions are obtained for the characteristic parameters of the channel (radius, temperature, etc.). 10 Refs.

Primary Keywords: Spark Channel; Hydrodynamic Model; Moderate Currents; Shock Wave; Channel Interior; Channel Exterior; Theory  
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7792  
(BREAKDOWN STUDIES)  
(Surface Flashover)  
THEORY OF THE SECONDARY ELECTRON AVALANCHE AT ELECTRICALLY STRESSED INSULATOR-VACUUM INTERFACES  
K. D. Bergeron

Sandia Lab., Albuquerque, NM 87115  
Journal Of Applied Physics, Vol. 48, No. 7, pp 3073-3080 (07/1977).

Several aspects of the secondary emission avalanche along an insulator surface (which is believed to play a role in insulator flashover) are addressed theoretically. The saturation condition for the two extremes of supply-limited and space-charge-limited current are obtained in analytic form, and comparison with the computer simulation of Anderson is made. Also, the effect of a strong magnetic field parallel to the insulator surface and perpendicular to the electric field is analyzed, taking into account of the distribution of emission angles. It is found that the critical magnetic field for inhibition of flashover is reduced by a factor of about 2 when the distribution of angles is included in the calculation. 14 Refs.

Primary Keywords: Surface Flashover; Vacuum Environment; Polyethylene Dielectric; Glass Dielectric; Secondary Emission; Supply-Limited Current; Space-charge-limited Current  
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7799  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
CA SEPARATION OF UNIFORM-FIELD SPARK-GAPS FOR HIGH-VOLTAGE MEASUREMENT AT POWER FREQUENCIES  
F. M. Bruce

English Electric Valve Co Ltd, Chalmersford, Essex, UK  
Proceedings Of The IEE, Vol. 94, Pt. 31, No. 38, pp 132-134 (04/1947).  
Spark gaps have been used to measure high voltage. The best design allows breakdown through a uniform field to provide good repeatability. The authors describe such a spark and derive an empirical relationship for the gap breakdown in the range 9-315 kV. An accuracy of 2% is claimed for the formula. 11 Refs.

Primary Keywords: Voltage Measurement; Spark Gap Diagnostic; Gap Calibration; Empirical Formula; Gap Preparation  
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7800  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES)  
(Lightning; Gas, Electrical)  
COMPARISON OF LIGHTNING AND A LONG LABORATORY SPARK  
M. A. Umar

Westinghouse Research and Development Center, Pittsburgh PA  
Proceedings Of The IEE, Vol. 59, No. 4, pp 457-460 (04/1971).  
Long laboratory sparks are often considered to be miniature lightning. The solvent properties of 4-m sparks created by impulse breakdown between a negative rod and a grounded plane by the Westinghouse Trafford 6.4 MV impulse generator are compared with those properties of natural lightning. In particular, a comparison is made of the luminous processes associated with breakdown, the current, voltage, power, and energy inputs to the discharges, the radiated visible spectra, the temperature, electron density, and pressure in the discharge channels, the absolute broad-band radiation in the visible and near infrared wavelength range, and the radiated acoustic signals. The spark return stroke most resembles a weak subsequent stroke in a multiple stroke lightning flash. The leader processes of the spark differ considerably from those of lightning. 19 Refs.

Primary Keywords: Lightning; Air Breakdown; Rod-plane Gap; Voltage Measurement; Current Measurement; Luminosity Measurement  
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7801  
(PARTICLE BEAMS; ELECTRON)  
(Generation)  
DEVELOPMENT OF AN ADVANCED PULSED ELECTRON BEAM ACCELERATOR  
P. Chennov, G. I. Hatch, K. Nielsen, S. Shope and I. Smith

Physic International Co, San Leandro, CA 94577  
Final report, Jan-Aug 72, No. PIFR-226, 105p (10/1972).  
Availability: AD-751 533

The report covers the development of a 50-kJ generator capable of producing currents in excess of one megampere at voltages approaching the megavolt with a pulse width about 55 nsec. The concept is to feed an electron accelerating tube from two modules, each containing a Particle Multiplier Striplines arranged in a series-parallel configuration. Each module contains 8 Blumlines with a total output of 0.5 to 1.1 MV. The modular concept permits the individual Mylar tubes to be assembled in air and vacuum-impregnated with copper sulphate solution. The module and its striplines are easily attached to the accelerating tube. Additional modules can be added to the present ones to increase the machine power output. (Author)

Primary Keywords: Electron Accelerators; Design; Electron Beams; Pulse Generators; Electrodes; Strip Transmission Lines; Dielectrics; Electric Switches  
Secondary Keywords: Marx Generators



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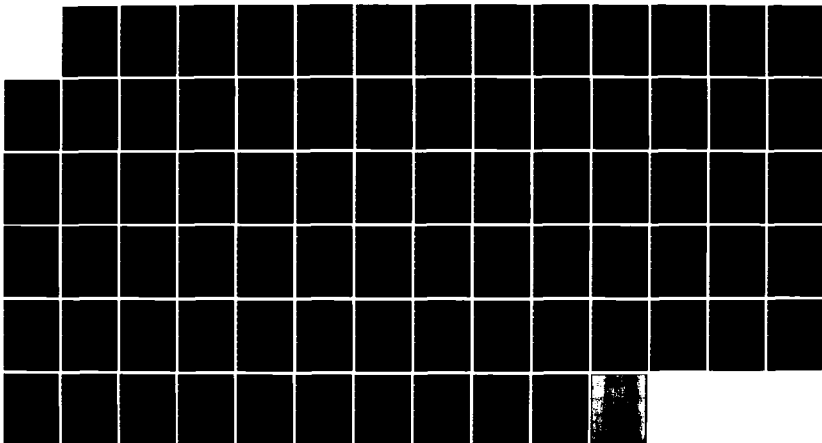
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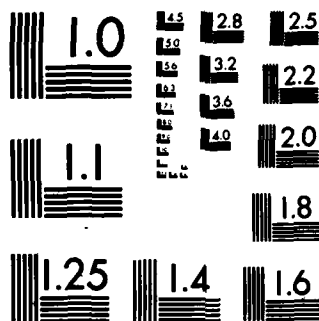
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MICROCOPY RESOLUTION TEST CHART  
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7802  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
EFFECTS OF FORCED CONVECTION UPON THE CHARACTERISTICS OF A STEADY-STATE CROSS-FLOW ARC IN THE PRESENCE OF AN APPLIED TRANSVERSE MAGNETIC FIELD  
A. J. Baker and D. M. Benenson  
State University of New York at Buffalo, Buffalo, NY 14226  
Proceedings Of The IEEE, Vol. 59, No. 4, pp 450-456 (04/1971).  
Experiments were conducted upon a 130-A 1.1-atm balanced argon arc over a range of velocities from 5.09 to 13.13 m/s; electrode spacing was 12.7 mm. Two stable modes of operation were found: the colinear mode, with arc attachments fix at the apexes of the electrodes, and the upstream mode, with arc attachments on the upstream sides of the electrodes. Below a critical velocity of about 5 m/s, the colinear mode only was found. For the colinear mode, arc isotherms, distributions, cross-sectional shape, and profile varied markedly with distance along its length; these were observed to be relatively uniform for the upstream mode. Significant lateral broadening of both configurations was found. The effect of velocity upon the upstream mode was to decrease the relative broadening of the plasma. 7 Refs.  
Primary Keywords: Steady Arc; Cross-flow Arc; Transverse Magnetic Field; Two Operating Modes; Critical Velocity; Arc Broadening  
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7803  
(SWITCHES, CLOSING)  
(Gas Gaps, Optical)  
EFFECTS OF TARGET-ELECTRODE POLARITY AND FOCAL-PLANE POSITION ON A LASER-TRIGGERED GAP  
V. A. Rodichkin and G. Ya. Ruzakova  
D.V. Efremov Institute, Leningrad, USSR  
Soviet Physics-Technical Physics, Vol. 18, No. 2, pp 223-224 (08/1973).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 43, 345-348 (February 1973).  
Delay measurements are given for breakdown in an 11.7 mm air gap triggered by a ruby laser with a power of 20 MW. The triggering time is measured as a function of applied voltage for various positions of the focal plane of the lens and target polarities. In the voltage range (0.6-1.0) kV/sub 0.7 is the gap breakdown voltage, the delay is reduced as the focal plane recedes from the surface of the target; the delay is smaller when the target electrode acts as the anode. If  $U < 0.6$  kV/sub 0.7, minimum delays are observed when the radiation is focused on the cathode in the gap. The results are interpreted in terms of shadow studies of channel formation. 6 Refs.  
Primary Keywords: Polarity Effects; Ruby Laser; Air Gap; Delay Measurement; Delay Variation With Focal Point  
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7804  
(INSULATION, MATERIAL; DIAGNOSTICS AND INSTRUMENTATION)  
(Solid; E-field)  
ELECTRIC STRESSES AT CONDUCTING SURFACES LOCATED IN THE FIELD BETWEEN PLANE PARALLEL ELECTRODES  
B. Salvage  
Queen Mary College, London, UK  
Proceedings Of The IEE, Vol. 111, No. 6, pp 1173-1176 (06/1964).  
Following the reasoning of a previous paper, the authors calculate the E fields at the boundaries of conducting bodies placed between parallel-plane electrodes. Elliptical cylinders and oblate spheroids are considered with their major axes parallel to the field. Several specific calculations are performed with results presented. 4 Refs.  
Primary Keywords: E-field Calculation; Elliptical Cylinder; Oblate Spheroid; Parallel-plane Electrodes; Laplace's Equation  
COPYRIGHT: 1964 IEE

7805  
(INSULATION, MATERIAL; BREAKDOWN STUDIES)  
(Solid; Gas)  
ELECTRIC STRESSES IN GASEOUS CAVITIES IN SOLID DIELECTRICS  
B. Salvage  
Leeds University, Leeds, UK  
Proceedings Of The IEE, Vol. 111, No. 6, pp 1162-1172 (06/1964).  
The E fields in elliptical cylindrical and oblate spheroidal cavities in a solid dielectric are the subject of this paper. The E fields are calculated for the general case of these cavities for several cases of parallel-plane electrodes. Several specific cases are considered with data presented. 18 Refs.  
Primary Keywords: Solid Insulation; Gaseous Cavity; Elliptic Cylindrical Cavity; Oblate Spheroidal Cavity; E-field Calculation; Parallel-plane Electrodes  
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7807  
(ELECTROMAGNETIC LAUNCHERS)  
(Railguns)  
ELECTROMAGNETIC ACCELERATION OF MACROPARTICLES TO HIGH VELOCITIES  
S. C. Rashtch and R. A. Marshall  
Australian National University, Canberra, Australia  
Journal Of Applied Physics, Vol. 49, No. 4, pp 2540-2542 (04/1978).  
An inductively driven rail-gun macroparticle accelerator has been built in which velocities of 5.9 km/s have been obtained using an arc as the driving armature. Simple theory is shown to be adequate for predicting rail-gun performance up to that velocity and for designing rail guns for launching large masses. 7 Refs.  
Primary Keywords: Rail Gun; Inductive Energy Store; Arc Driver; Performance Test  
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7808  
(BREAKDOWN STUDIES)  
(Gas; Electrical)  
FORM FACTOR METHOD YIELDS THERMAL CONDUCTIVITY AND RADIATED POWER OF NITROGEN ARC  
H.M. Pfenz (1) and D.T.J. Ter Horst (2)  
(1) Allis-Chalmers, Boston Plant, Boston, MA  
(2) Eindhoven University of Technology, Eindhoven, Netherlands  
Proceedings Of The IEEE, Vol. 59, No. 4, pp 601-604 (04/1971).  
The form factor method for the determination of thermal conductivity is applied to experimental results obtained with a cascade arc in nitrogen. Experimental and theoretical thermal conductivities agree, even at temperatures above 10000 Deg. K. is rather high radiation losses are taken into account. This result does not change significantly when absorption is considered by means of an absorption form factor and the total absorbed power. 11 Refs.  
Primary Keywords: Nitrogen Arc; Cascade Arc; Thermal Conductivity; Radiated Power; Experiment; Theory; Form Factor Method  
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7809  
HIGH VOLTAGE PULSER TECHNIQUES FOR ELECTROMAGNETIC PULSE (EMP) SIMULATORS  
J. S. Granados, J.T. Naff, M.F.J. Creason and C.H.J. Jones  
AFML, Kirtland AFB, NM 87117  
Final rept. Sep 72-Jun 74 (07/1975).  
Availability: AD-8013 783/65T  
NTIS  
This report presents the results of both theoretical and practical investigations aimed at improving the performance of a number of key components that are common to many EMP high voltage generators. The advantages of component redundancy over attempting to achieve extreme individual component reliability are outlined. Common capacitor faults are discussed together with methods of their detection and techniques for circumventing a failed capacitor in a Marx generator. Marx switch faults and timing irregularities are also discussed. A specific design for a high voltage fuse for use in Marx generator circuits which was developed and tested is presented. A cascade high voltage represswitch is discussed.  
Primary Keywords: Electromagnetic Pulse Simulators; Pulse Generators; High Voltage; Electric Switches  
Secondary Keywords: NTISDDAF

7810  
(BREAKDOWN STUDIES)  
(Gas; Electrical)  
INDUCED RADIAL VELOCITY IN NONSTATIONARY ELECTRIC ARCS  
R.L. Phillips  
University of Michigan, Ann Arbor, MI  
Proceedings Of The IEEE, Vol. 59, No. 4, pp 466-473 (04/1971).  
An analysis is presented of the effects of induced radial velocity on the thermal behavior of a nonstationary electric arc. An interrupted DC arc is simulated by treating the linearized equations for a cylindrical plasma, initially at a uniform temperature, when the wall temperature is suddenly changed by a small amount from the gas temperature. Due to compressibility, a radial wave motion is set up within the gas which causes rapid interior temperature changes on a time scale much smaller than the conduction time constant. For example in a 5-mm diameter SF/sub 6/ arc, which is initially at a temperature of 11000 Deg. K., the central temperature will change by 20 percent in 1 microsecond, while the conduction time constant is 100 microseconds. The possible importance of this behavior for circuit breaker arcs is discussed. 12 Refs.  
Primary Keywords: Nonstationary Arc; DC Arc; Theory; Cylindrical Geometry; Wall Cooling; Radial Motion; SF/sub 6/ Arc  
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7811  
(BREAKDOWN STUDIES)  
(Gas; Electrical)  
INFLUENCE OF DIFFUSION AND NONEQUILIBRIUM POPULATIONS ON NOBLE-GAS PLASMAS IN ELECTRIC ARCS  
J.F. Uhlenbusch and E. Fischer  
University of Aachen, Aachen, FRG  
Proceedings Of The IEEE, Vol. 59, No. 4, pp 578-587 (04/1971).  
Measurements and calculations of temperature, densities, and field-strength-current characteristics of cascade arcs burning in noble gases under atmospheric pressure are reported. The evaluation of measured arc data assuming Saha equilibrium, complete local thermal equilibrium (LTE), is not in agreement with the detailed solution of the balance equations. Solutions of these equations are compared with results following from measured line intensities only solving the rate equations in connection with the electron energy balance and the equation of state. For helium, both methods give results which agree within a few percent. The deviations from Saha equilibrium are caused by diffusion and the overpopulation of ground state atoms. The excited atoms, however, are nearly in equilibrium with free electrons in the range of electron densities reached in our experiment (partial LTD). Measurements of E-I characteristics agree with calculated data, if diffusion is taken into account. A simple criterion for diffusion-dominated plasma and a plasma in thermal equilibrium is derived. 19 Refs.  
Primary Keywords: Noble Gas Breakdown; Atmospheric Pressure; Temperature Measurement; Experiment; Theory; Saha Equation  
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7812  
(INSULATION, MATERIAL; BREAKDOWN STUDIES)  
(Gas; Gas; Electrical)  
INSULATION PROPERTIES OF COMPRESSED ELECTRONEGATIVE GASES  
F. R. Howard  
Proceedings Of The IEE, Vol. 104, Part A, No. 14, pp 123-138 (04/1957).  
The breakdown voltages of several gases are determined for AC, DC, and impulse voltages and for RF in this paper. Among the gases tested are SF/sub 6/, CF/sub 4/, CCl/sub 4/, and CBr/sub 4/. Several field configurations were used, gas pressure was varied, and the experiments were conducted both with and without ionizing radiation present. 35 Refs.  
Primary Keywords: Gas Insulation; Dielectric Strength; Gas Breakdown; Several Gases; SF/sub 6/ Gas; Fluorocarbon Gases; DC Voltage; AC Voltage; Impulse Voltage; Radiation  
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7815  
(BREAKDOWN STUDIES)  
(Gas; Electrical)  
IONIZING GAS BREAKDOWN WAVES IN STRONG ELECTRIC FIELDS  
R. Klingbeil, D.A. Tidman and R.F. Fernsler  
University of Maryland, College Park, MD 20742  
The Physics Of Fluids, Vol. 15, No. 11, pp 1949-1973 (11/1972).  
An analysis of ionizing potential waves is made which includes photoionization. It is found that photoionization plays an important role in the avalanche propagation. Velocities, electron densities, and temperatures are given as a function of electric field for both negative and positive breakdown waves in nitrogen. 11 Refs.  
Primary Keywords: Ionizing Potential Wave; Avalanche Breakdown; Photoionization; Avalanche Velocity; Nitrogen Gas  
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7817  
(BREAKDOWN STUDIES)  
(Liquid, Electrical)  
OBSERVATIONS ON THE INTERMITTENT ELECTRON EMISSION IN LIQUEFIED NITROGEN  
Y. Murase  
Defense Academy Of Japan, Hashirimaizumi, Yokosuka, Japan  
Journal Of Applied Physics, Vol. 48, No. 1, pp 136-142 (01/1977).  
The prebreakdown mechanism in liquefied nitrogen has been studied by using a modified optical Schlieren system. The present method has the advantage of observing the drift velocity of the disturbance in liquids and the prebreakdown mechanism by using a small disk instead of a knife edge. Thus the disturbance occurring due to the charge carriers can be recorded on the screen with an intensity which is proportional to the rate of the refractive index change. The mobilities of the negatively charged carriers derived from the drift velocity of the disturbance fall in the range of  $1.1 \times 10^{-2} - 1.05 \times 10^{-1}$  sq.cm./V sec) in liquefied nitrogen, and also that of the quasifree electrons localized in the tiny bubbles ( $7.95 \times 10^{-4}$  sq.cm./V sec) as calculated theoretically. 17 Refs.  
Primary Keywords: Liquid Nitrogen Breakdown; Prebreakdown Mechanism; Schlieren Diagnostics; Disk Beam Obstruction; Charge Carrier Mobility; Gas Bubbles  
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7818  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
PREDICTION OF CONDITIONS FOR A SINGLE PULSE DISCHARGE  
P.M. Sherman  
University of Michigan, Ann Arbor, MI  
Journal Of Applied Physics, Vol. 48, No. 1, pp 143-144 (01/1977).  
An empirical method is presented for the prediction of conditions necessary to obtain a single pulse discharge with no oscillation, no restriking, and no residual energy stored with zero current and zero voltage at the end of the pulse. An LRC circuit with a 14.7-microFarad capacitor charged to voltages between 2000 and 20000 V and discharging through wires of different metals was employed to obtain necessary conditions. It is shown that specific resistivity and specific heat of fusion of the wires can be used to predict the charge voltage necessary for the single pulse discharge for a given system. 3 Refs.  
Primary Keywords: Single Pulse Discharge; No Oscillation; No Restrike; No Residual Energy; RLC Circuit; Capacitor Charging Circuit  
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7819  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
PRINCIPLES OF ARC MOTION AND DISPLACEMENT  
H.M. Maecher  
Universitat Munchen, Munich, FRG  
Proceedings Of The IEEE, Vol. 59, No. 4, pp 439-449 (04/1971).  
It is shown that the motion of an arc being described as a temperature cloud can be divided into two parts, one being the relative velocity of the arc phenomenon with respect to the mass flow and the other the mass motion itself. The first relative motion is determined by the equation for the change of internal energy with time, the second mass flow has to be calculated by means of the magnetohydrodynamic and continuity equations. Three groups of examples are given in each of which one of the three velocities disappears. In the first group, no mass flow exists and the motion of the arc is caused by various types of inhomogeneous heating. In the second group, the arc itself does not move due to the opposing effects of mass motion and relative arc motion. In the last group, the arc follows the mass flow without relative motion. As long as the boundary conditions do not change from the standpoint of the arc the motion continues steadily. If, however, the boundary conditions form any type of obstacles, the motion of the arc ends up in a new equilibrium position, a displacement occurring. 12 Refs.  
Primary Keywords: Arc Motion; Arc Velocity; Mass Velocity; Theory; Energy Balance; Magnetohydrodynamic Mass Flow; Boundary Condition  
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7821  
(BREAKDOWN STUDIES)  
(Surface Flashover)  
PULSED FLASHOVER OF INSULATORS IN VACUUM  
D. Milton  
Sandia Labs, Albuquerque, NM 87115  
IEEE Transactions On Electrical Insulation, Vol. EI-7, No. 1, pp 9-15 (03/1972).  
Dielectric specimens in the shape of a frustum of a cone were evaluated for surface flashover strength in vacuum of  $10^{-5}$  Torr. Data were obtained for positive and negative pulses of several hundred kilovolts amplitude and with rise times in the nanosecond and microsecond region. The results indicate that most materials exhibit a greater resistance to breakdown if the base of the cone is at the cathode and that the strength is greatly affected by the angle at the dielectric makes with the applied field. Lucite, polystyrene, polyethylene, cast Nylon, and 7740 glass are shown to be relatively resistant to flashover in comparison with the ceramics and molded plastics. It is also observed that the surface strength in vacuum is a small fraction (approximately 1/10 or less) of the volume strength and consequently breakdown through the bulk seldom occurs. Data are given for several common insulating materials. 13 Refs.  
Primary Keywords: Surface Flashover; Vacuum; Lucite; Polystyrene; Polyethylene; Nylon; Glass; Field Angle; 100 kV Test Voltage  
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7822  
(BREAKDOWN STUDIES)  
(Electrodes, Recovery)  
REFRACTORY ELECTRODE REGION RECOVERY FOLLOWING ARC INTERRUPTION  
K.G. Evans, DC Strachan and M. Edels  
University of Liverpool, Liverpool, UK  
Proceedings Of The IEEE, Vol. 59, No. 4, pp 525-534 (04/1971).  
Measurements are presented of the voltage fall across the electrode region of low-current carbon arcs when test current pulses are injected through the arc gap at some time (less than 100 microseconds) following rapid removal of the arc current. The results thus shed some light upon the thermal reinitiation phenomena of refractory electrodes. A model is proposed to describe the observed behavior at low initiation current levels. This model may also be of assistance in describing the behavior of hot probes in high-pressure plasmas. Although the model is not extended to high current levels, a discussion is presented of the electrode region behavior for currents at which mechanisms apparently form, which are necessary for reinitiation and steady-state conduction through the electrode regions. 11 Refs.  
Primary Keywords: Gas Discharge; Carbon Electrodes; Arc Interruption; Recovery Processes; Voltage vs Current  
Secondary Keywords: Plasma Probe  
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7823  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
SPECTROSCOPIC STUDY OF HIGH CURRENT DISCHARGES  
T. Ito, Y. Ueda, M. Komura and T. Nitta  
Mitsubishi Electric Corp, Amagasaki, Japan  
Proceedings Of The IEEE, Vol. 59, No. 4, pp 573-577 (04/1971).  
A high current arc was developed between carbon electrodes in H/sub 2/ at 27.5 MPa, 67.5 MPa, and air at an initial pressure higher than 1 atm. The current peak was above 5 kA and the duration of the current was 250 microseconds. The temporal and spatial changes of plasma parameters were measured by time-resolved spectroscopy and high-speed framing camera. The electron density of the plasma was estimated from the Stark broadening of the lines H/sub 2/ beta/ C 4267 Angstrom, H<sub>2</sub> 4471 Angstrom, and H<sub>2</sub> 5876 A. Our observations show the following: The arc space is divided into two regions, the bright narrow core and the broad outer flame. The electron density of the core is estimated to be of the order of  $10^{18}$  cm/sup 3/ and an electron temperature of the order of  $10^4$  Deg.k is obtained at current peak. Even after current zero, the electron density keeps the order of  $10^{17}$  cm/sup 3/ regardless of the kind of gas. 9 Refs.  
Primary Keywords: High Pressure Discharge; 5 kA Current; 250 Microsecond Duration; Spectroscopy; Framing Camera; Electron Density  
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7827  
(BREAKDOWN STUDIES; SWITCHES, OPENING)  
(Gas, Electrical; Mechanical)  
THE TIME CONSTANT OF HIGH VOLTAGE CIRCUIT BREAKER ARCS BEFORE CURRENT ZERO  
J. Urbanek  
Brown, Boveri & Co Ltd, Baden, Switzerland  
Proceedings Of The IEEE, Vol. 59, No. 4, pp 502-508 (04/1971).  
It has been shown that the relative rate of decrease of conductance of the arc in the following called RRDC, can be split in terms depending on the changing of the quantities: arc length, arc cross section, peak arc temperature and temperature profile, and the order of magnitude of the different terms has been estimated. For an experimental air blast breaker current and voltage near current zero have been measured for the case of a short line fault and the RRDC function has been calculated in the time interval 20-1 microsecond before current zero. It has been shown that the often used theory of Mayr is not applicable over the whole of the investigated time interval and also that the theory of Cassie does not apply in the time interval preceding 10 microsecond before current zero. In the last 10 microsecond before current zero Cassie's theory describes the investigated air blast breaker quite well. The transient behavior of the arc conductance (e.g., Cassie's time constant) in the air blast breaker has been found to be of the same order of magnitude (approximately 0.5 microns) as has been reported for SF/sub 6/ gas blast breakers. This has been explained by the fact that the RRDC function is mainly dependent on the variation in the arc cross section, which seems to be only slightly dependent on the quenching medium. Because this reasoning is only valid before current zero, greater differences of the transient arc behavior of different breakers may occur at and after current zero. 7 Refs.  
Primary Keywords: Air Blast Circuit Breaker; Conductance; Temporal Resolution; Variable Length; Variable Cross Section  
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7836  
(BREAKDOWN STUDIES)  
(Gas, Optical)  
CHARACTERISTICS OF LASER-INITIATED IONIZATION CHANNELS IN AIR  
R. Fernald, I.M. Vitkovitsky, A.W. Ali, J.R. Graig, R.E. Pachacek and M. Raleigh  
Naval Research Lab, Washington, DC 20375  
1977 IEEE International Conference On Plasma Science, pp 63 (05/1977).  
The production of ionized channels in air has many applications such as the understanding and controlling of lightning, switching in high pressure gasses and propagation of electron beams. Initiation and direction control are common requirements in these applications. Among the methods for producing the ionized channels is the use of intense laser beams. Such beams form intermittent ionization. Sufficiently strong superimposed electric fields lead to discharges that produce uniform ionization channels. Characteristics of these types of ionization channels have been studied to determine the channel length and electrical properties as a function of laser parameters. 3 Refs.  
Primary Keywords: Uniform Ionization Channel; Channel Length; Electrical Properties  
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7835  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
ELECTRICALLY EXPLODED WIRES-EXPERIMENTS AND THEORY  
J.B. Langworthy, R.C. O'Rourke, M.P. Shuler, I.M. Vitkovitsky, C.B. Dobbs, R.J. Veith and D.F. Hansen  
Naval Research Lab, Washington, DC 20375  
NRL Report No. 5489 (06/1968).  
Availability: AD 258144  
NTIS  
This report theoretically traces the absorption of electrical energy by the wire and the behavior of the wire as its energy content is increased. Several simplifying assumptions are made to make the problem tractable while retaining physical significance. The application of exploding wires to soft X-ray production is discussed. An extensive description is given of the NRL exploding wire laboratory with nitrogen, water, and combination mylar-water capacitors characterized. 9 Refs.  
Primary Keywords: Exploding Wire; Soft X-ray Production; Water Capacitor; Mylar Capacitor; Mylar-water Capacitor; Experiment; Theory

7874  
(ENERGY STORAGE, MECHANICAL)  
(Rotating Machines)  
PULSED HIGH VOLTAGE AND HIGH CURRENT OUTPUTS FROM HOMOPOLAR ENERGY STORAGE SYSTEM  
R.D. Ford, D. Jenkins, M.H. Lupton and I.M. Vitkovitsky  
Naval Research Lab, Washington, DC 20375  
Memorandum rept. No. NRL-4433, 16p (02/1981).  
Availability: AD-A094 918/7  
NTIS

Large energy storage capability of inertial-inductive systems provides an attractive option for satisfying the pulse power requirements associated with such applications as plasma confinement and heating, electromagnetic projectile acceleration and with production of intense radiation. These applications require high rate of energy delivery to the load at specific current and voltage levels. In conjunction with self-excited homopolar generator current source, an opening technology has been developed to provide up to 1 MJ output pulses, alternately, at hundreds of kilovolts or at megampere levels. The overall system efficiency, that depends sensitively on the load requirements, was measured over a range from 10% to more than 90% for different pulser-load circuit arrangements. (Author)

Primary Keywords: Pulse Generators; Electromagnetic Pulses; Plasma Generators; High Voltage; Prototypes; Efficiency; Heating; Plasmas(Physics); Confinement(General); Energy Transfer  
Secondary Keywords: Homopolar Generators; High Current; NTISDDX

7888  
(INSULATION, MATERIAL)  
(Liquid)  
LIQUID MOTION AND INTERNAL PRESSURE IN ELECTRICALLY STRESSED INSULATING LIQUIDS

J.S. Mirza, C.W. Smith and J.M. Calderwood  
University of Salford, Salford, UK  
Journal Of Physics D: Applied Physics, Vol. 3, pp 580-583 (03/1978).  
The electrical conductivity of hexane and transformer oil was found to be reduced by filtering the liquid through filters of pore size down to 10 nm, whereas no change in the liquid motion under the applied electric stress could be detected. It is concluded that a part of the measured conductivity is due to the charge carried by particles and that the particles are not the main cause of the liquid motion. Effects of the pressure developed in electrically stressed insulating liquids and of cavitation at the electrodes are discussed. At high fields, liquid jet motion from a point electrode is reported and evidence suggests that the charge in the jet may be carried within a spray of bubbles produced by cavitation at the electrodes. 11 Refs.

Primary Keywords: Insulating Liquids; Hexane; Transformer Oil; Conductivity Measurements; Liquid Circulation Measurement; Cavitation Effects  
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7900  
(PARTICLE BEAMS, ELECTRON)  
(Review)  
ELECTRON BEAM FUSION PROGRESS REPORT: APRIL THROUGH SEPTEMBER 1977  
Authors Unknown  
Sandia Labs, Albuquerque, NM 87115  
Sandia Report No. SAND78-0080 (04/1978).  
Availability: SAND78-0080  
NTIS

This report provides an overview of the progress made on the electron beam fusion program at Sandia laboratories from April through September 1977. Results from Proto II and the superfast Z-pinch experiment are presented along with theoretical studies of the physics power flow and e-beam generation. Refinements in the design of CBs are also discussed. 157 Refs.  
Primary Keywords: Electron Beam Fusion; Magnetic Insulation; Marx Generator; Trigonon; Vacuum Diode; Vacuum Flashover  
Secondary Keywords: Diagnostics

7901  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
HIGH REPETITION RATE SPARK GAP

Authors Unknown  
MLR Report No. MLR-640 (03/1977).  
Availability: UCR1 13718  
NTIS

The design, construction, and testing of a high repetition rate spark gap are described. The gas flow control, the high voltage trigger generator, the Blumlein charging system, and the proper control of these components are discussed. Lack of working equipment and funds limited the project so that the finished spark gap could only produce three pulses at 1 ms intervals with an amplitude of 10 kV. 8 Refs.

Primary Keywords: Field Distortion Gap; Rep-rated; Blumlein Line; Triggering; Diagnostics

7902  
(PARTICLE BEAMS)  
(Generation)  
A NEW COLLECTIVE PARTICLE ACCELERATOR

M. Friedmann  
Naval Research Lab, Washington, DC 20375  
NRL Report No. NRL 3724 (02/1978).  
Availability: AD A053759/7  
NTIS

A simple and novel mechanism for a collective particle accelerator is proposed. It is suggested that a density modulated intense relativistic electron beam propagating in a spatially modulated magnetic field can drag particles (electrons or ions) and accelerate them to high energies. This new mechanism can generate high particle current. A strong radial electric field exists in the mechanism ensuring radial confinement of the accelerated ions. 12 Refs.  
Primary Keywords: Electron Acceleration; Ion Acceleration; Heavy Ion Acceleration; Collective Acceleration

7903  
(ENERGY STORAGE, INDUCTIVE; SWITCHES, OPENING)  
(Systems; Explosive Fuses)  
INDUCTIVE CHARGING OF PULSE LINES IN 0.1 TO 1.0 MJ RANGE USING FOIL FUSES STAGED WITH EXPLOSIVELY ACTUATED SWITCHES  
D. Cento, R. Ford, M.H. Lupton, J.D. Shipman Jr., P. Turchi and I.M. Vitkovitsky  
Naval Research Lab, Washington, DC 20375  
NRL Report No. NRL 3472 (03/1978).  
Availability: NRL 3472  
NTIS

The use of inductive storage techniques to replace the conventional high voltage sources, such as Marx generators, for the charging of high voltage transmission line pulse generators (i.e., capacitive loads) is discussed. The proposed opening switch system consists of exploding foil fuses staged with high explosive actuated switches. The low resistance of the explosive switches in the closed stage allows the inductive store to be charged at relatively slow rates without significant energy loss. Upon opening, current is commutated to the foils which rapidly explode to generate the inductive voltage necessary to charge the load. A detailed analysis of fuse performance in the basic inductive storage circuit is presented using empirically obtained data on the resistivity vs. dissipated energy characteristic of vaporized aluminum foils. The results are used to outline the design of inductive storage systems for pulse charging capacitors to 1 MV at energies from 100 to 1000 kJ, with rise times of 2 to 10 microseconds (1E11 to 1E12 W rate) and efficiencies of 20 to 65%. 17 Refs.

Primary Keywords: Inductive Storage; Fuses; Current Interruption; Pulse Charging Capacitors; Transmission Line Pulse Generators

7904  
(DIAGNOSTICS AND INSTRUMENTATION; SWITCHES, OPENING)  
(Miscellaneous; Explosive Fuses)  
INTERPRETATION OF X-RAY LINE SPECTRA FROM EXPLODED-WIRE ARRAYS  
P. Burkhalter (1), J. Davis (1), J. Rauch (2), M. Clark (2), G. Donibacka (3) and R. Schneider (3)  
(1) Naval Research Lab, Washington, DC 20375  
(2) Maxwell Labs Inc, San Diego, CA 92123  
(3) Physic International Co, San Leandro, CA 94577  
NRL Report No. NRL 3723 (03/1978).  
Availability: NRL 3723  
NTIS

Temperatures and densities were determined from the plasma implosion formed at the center of symmetrical exploded-wire arrays. Temperatures of 500-850 eV were found from line ratios in Al and Si shots using various plasma models. The recombination temperatures for these elements were 400-500 eV. Higher implosion temperatures of 1.5 to 2 keV were found in Ti and Fe shots and of 2.5 to 4 keV for Mo wire shots. The densities were approximately 1E20 cm<sup>3</sup> sup -3/ for the spatially integrated implosion region. Intense emitting regions of approximately 500 micron in size were observed in densitometer contours of Al plasma pinhole images. 13 Refs.

Primary Keywords: X-ray Spectra; Exploded-wires

7905  
(SWITCHES, OPENING; DIAGNOSTICS AND INSTRUMENTATION)  
(Explosive Fuses; Miscellaneous)  
SPECTROSCOPY AND X-RADIATION FROM EXPLODED-WIRE ARRAYS AND GAS PUFF PLASMAS

P. Burkhalter and J. Davis  
Naval Research Lab, Washington, DC 20375  
NRL Report No. NRL 3434 (03/1979).  
Availability: AD-A072 018/55T  
NTIS

In this report results are presented for three separate experiments involving multiple exploded wire arrays and puff gas plasmas. The first section deals with the analysis and interpretation of x-ray line spectra from a variety of exploded multiple wire arrays including Al, glass, Ti, SS, Mo, and W wires. The second section deals with x-ray spectra from a gas puff Z-pinch device, operated at the University of California, Irvine, that provides both spatial and spectral information of an x-ray emission. 25 Refs.

Primary Keywords: Exploding Wire Arrays; Wire Plasmas; Gas Puffs; Spectroscopy

7906  
(PARTICLE BEAMS, ELECTRON; PARTICLE BEAMS, ELECTRON; DIAGNOSTICS AND INSTRUMENTATION)  
(Generation; Transport; Miscellaneous)  
INTENSE ELECTRON BEAM GENERATION AND COMPRESSION

R. Ecker, V. Buck, T.S.T. Young, D. Lopez and S. Chao  
Physic International Co, San Leandro, CA 94577  
DNA Report No. DNA 4523F (01/1978).  
Availability: AD A059715  
NTIS

Intense electron beam generation and compression in a converging magnetic guide field has been studied experimentally and theoretically. Beams from the CWL II generator with peak parameters of typically 350 nA, 1.2 MeV and 120 nsec (FWHM of power pulse) have been diagnosed before and after factor-of-three area compression, using a newly constructed multi-collector Faraday cup for current density profile measurements, and a multi-layered or filtered Faraday cup for time-resolved electron angle measurements and time-integrated charge deposition profile measurements. Both diagnostics were successfully used at dose levels up to about 4800 cal/cm. The effect of reflected electrons on diode behavior has been examined and found to be non-negligible for certain target configurations. Experimental results have been used to test the calculations of the REEFER diode code and of the new code, REFLEX, which was developed in this program to evaluate compressed-beam transport according to the Young-Spence model. 13 Refs.

Primary Keywords: Pulsed Electron Beams; High Dose; Beam Compression; Faraday Cup; Beam Transport Efficiency; Beam Current Profile; Diode Code (REEFER); Transport Code

7907

(PARTICLE BEAMS, ION)

(Generation)

ELECTRODE EROSION PROCESSES IN PULSED PLASMA THRUSTERS

D.J. Palumbo, M. Begun and M.J. Guman

Fairchild Industries Inc. Farmingdale, NY 11735

AFRPL Report No. AFRPL-TR-79-14 (85/1979).

Availability: AD A69276

NTIS

During the course of this program it was determined that material melting is the primary physical phenomenon leading to erosion of the anode electrode. Experimentation with various materials indicated that minimum erosion of the anode was obtainable using Poco Graphite but significant impulse bit reduction due to the high resistivity of this material would be incurred if this material were used. The material yielding the next least amount of anode erosion was shown to be copper (DNFC). Various modifications in the thruster propellant/electrode configurations were attempted using Graphite in attempting to recover the loss of thruster performance associated with the use of this material as an anode electrode. These attempts were unsuccessful, and the decision was made about midway through the program to concentrate on minimizing the effects of the arc heat load on a copper anode surface by reconfiguring the electrodes and/or propellant rods. This approach to the problems not only led to a successful solution of the anode erosion problems, but also resulted in improved thruster performance and the capability of storing sufficient propellant to meet a total impulse requirement far in excess of the program goal using the original helical rod storage system with modified propellant rod width. 9 Refs.

Primary Keywords: Plasma Propulsion; Electrode Erosion; Arc Discharges  
Secondary Keywords: Electric Propulsion; Space Propulsion

7908

(INSULATION, MATERIAL)

(Liquid)

FLUID DIELECTRIC CUTS SIZE AND WEIGHT OF HIGH-POWER AIRBORNE EQUIPMENT. IT'S PARTICULARLY EFFECTIVE WITH HIGH-FREQUENCY RADIO AND RADAR TRANSMITTERS

L.K. Findley

Electronic Communications, Inc., St. Petersburg, FL 33733

Electronic Design, Vol. 18, No. 26, pp 44-45 (12/1978).

The use of fluid dielectric instead of air in high-power airborne equipment is proposed. Higher dielectric strengths, lower operating temperature, and other advantages are discussed. The potential disadvantage of the temperature dependence of the dielectric constant is addressed. 8 Refs.

Primary Keywords: Silicon Oil; High Dielectric Strength; Good Heat Transfer; Lubrication

Secondary Keywords: Airborne Equipment

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7909

(INSULATION, MATERIAL)

(Solid)

A NOVEL CONDUCTING GLAZE

E.A. Dancy

Hydro-Quebec Institute of Research, Verannes, Quebec, Canada

Ceramic Bulletin, Vol. 35, No. 6, pp 569-571 (06/1976).

Molybdenum is used as the conducting material in a conducting glaze with a very small temperature coefficient of resistance. Resistances of 1E4 to 1E5 ohm/square were easily obtained, and resistances of 1E6 to 1E8 ohm/square were obtained when particle size and composition were carefully monitored. 7 Refs.

Primary Keywords: Conducting Glaze; Wide Conductivity Range; Good Stability

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7910

(PULSE GENERATORS)

(Trigger)

HIGH-VOLTAGE PULSER SPARES BATTERY SUPPLY

M.J. Orr

National Research Council, Ottawa, Ontario, Canada

Electronics, Vol. 44, No. 1, pp 58 (05/1971).

A design for a high-voltage pulse generator which drains little current from the batteries is presented. An in-out pulse is used to trigger the generator, and delays are variable between 0.5 and 20 microseconds. Pulses of 300V with a rise time of 30 ns are generated. 8 Refs.

Primary Keywords: Battery Power; Low Duty Cycle; Monostable Multivibrator; Solid State; Low Jitter; Hundreds Of Volts Output

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7911

(SWITCHES, CLOSING)

(Gas Gaps, Optical)

A SIMPLE LASER-TRIGGERED SPARK GAP FOR KILOVOLT PULSES OF ACCURATELY VARIABLE TIMING

B. Travelet

Fighting Vehicles Research and Development Establishment, Chertsey, Surrey, UK

Opto-Electronics, Vol. 1, No. 1, pp 62-63 (02/1969).

Results of the performance testing of both a solid- and gas-dielectric laser-triggered spark gap are presented. Both gaps exhibited low jitter and low delay. The air gap produced somewhat more pulse distortion than the solid-dielectric switch, which utilized Malinex as the dielectric. 8 Refs.

Primary Keywords: Laser-triggered Spark Gap; Air Gap; Malinex Gap; Jitter; Measurement

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7913

(BREAKDOWN STUDIES; SWITCHES, CLOSING)

(Gas, Optical; Gas Gaps, Optical)

AN ELECTRICAL DISCHARGE THROUGH TWO LASER SPARKS

V.I. Vladimirov, G.M. Malyshov, G.T. Razdobrin and V.V. Semenov

A.F. Joffe Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Leningrad

Soviet Physics-Technical Physics, Vol. 13, No. 12, pp 1694-1695 (06/1969)

Trans. From: Zhurnal Tekhnicheskoi Fiziki 38, 2109-2111 (December 1968)

In this paper it is shown experimentally that an electrical discharge can occur between two separate laser sparks. From shadow photographs it is established that the electrical discharge arises at the time when the hot regions of the two sparks come in contact in the process of expansion. For an electrode voltage of 550 V the electrical discharge takes place for distances between the centers of the laser sparks up to 10 mm. The resistance of the discharge gap agrees well with the value of the discharge resistance through one laser spark. 1 Refs.

Primary Keywords: Double Laser Sparks; Spark Expansion; Spark Contacts; Current Flow

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7915

(SWITCHES, CLOSING; BREAKDOWN STUDIES)

(Gas Gaps, Optical; Gas Gaps, Optical)

BREAKDOWN OF A SPARK GAP IN AIR TRIGGERED BY A LASER

Y. Miyoshi, T. Hosokawa and M. Shintani

Nagoya University, Nagoya, Japan

Japanese Journal Of Applied Physics, Vol. 8, No. 5, pp 628 (05/1969).

In this paper, the self-breakdown voltage of a nonuniform field rod-plane gap is compared to the breakdown voltage of the same gap when irradiated with a giant pulse laser. The laser is focused on the plane electrode. The transition from corona self-breakdown to corona-less self-breakdown is studied and polarity effects of self-breakdown and laser-triggered breakdown are considered. 2 Refs.

Primary Keywords: Nonuniform Field Gap; Polarity Effects; Brass Electrodes; Formative Time Lag; Measurement

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7918

(BREAKDOWN STUDIES; BREAKDOWN STUDIES)

(Gas, Electrical; Gas, Optical)

CONTINUOUS LASER-SUSTAINED PLASMAS

D.L. Franzen

National Bureau of Standards, Boulder, CO 80302

Journal Of Applied Physics, Vol. 44, No. 4, pp 1727-1732 (04/1973).

Continuous plasmas sustained by a focused high-power CO/sub 2/ laser are described. The power required for maintaining a cw plasma following preionization has been determined for Xe, Kr, and Ar, and attempted for He and Ne. Measurements indicate the noble gases with the lowest ionization potentials have the lowest sustaining thresholds. Radiative properties of some of the plasmas were studied with calorimetric techniques. Under certain conditions, more than half of the incident laser radiation can either be scattered or absorbed by the plasma. A major loss mechanism for the plasma is shown to be radiation in the visible and ultraviolet. Spectra of low-pressure Xe plasmas indicate the presence of ultraviolet transitions with a high contrast to the continuum. 8 Refs.

Primary Keywords: CO/sub 2/ Laser; Preionized Plasma; Laser-maintained Plasma; Various Gases

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7924

(BREAKDOWN STUDIES; SWITCHES, CLOSING)

(Gas, Optical; Gas Gaps, Optical)

INVESTIGATION OF BREAKDOWN IN N/SUB 2/ UNDER THE INFLUENCE OF A PICOSECOND RUBY-LASER PULSE

I.K. Krasnyuk, P.P. Pashinin and A.M. Prokhorov

P.N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow, USSR

Soviet Physics JETP Letters, Vol. 9, No. 10, pp 354-356 (04/1969).

Trans. From: ZhETF Pis. Red. 9, 581-584 (May 1969)

Marked progress has been made by now in the generation and amplification of picosecond pulses of optical radiation. This extends greatly the experimental possibilities of studying optical breakdown in transparent media. Breakdown in gases can be produced, by varying the conditions of the experiment, both via the avalanche mechanism and by direct ionization of the atoms or molecules in the field of the strong light wave, whose frequency is much lower than the ionization potential. In the present study, we investigated the dependence of the breakdown threshold on the pressure in nitrogen gas at pressures from 2 to 1E4 mm Hg. The generation pulse duration ranged from 30 to 100 psec. 9 Refs.

Primary Keywords: Avalanche Breakdown; Threshold Intensity; Pulse Length Dependence

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7926

(BREAKDOWN STUDIES; SWITCHES, CLOSING)

(Gas, Optical; Gas Gaps, Optical)

LASER INITIATED SPARK DEVELOPMENT IN AN ATR GAP

F.M. Lindner, M. Rudolph, G. Brumme and H. Fischer

Angewandte Physik, Technische Hochschule Darmstadt, Darmstadt, FRG

Applied Optics, Vol. 14, No. 9, pp 2225-2228 (09/1975).

The authors utilize an image converter camera to follow the breakdown stages in a laser triggered spark gap. The phases seen were the production of a metal vapor jet, prechannel (leader), filament, and breakdown. It is surmised that the prechannel is caused by field enhancement due to the cloud of metal vapor extending into the gap. 10 Refs.

Primary Keywords: Ruby Laser; Breakdown Phases; Light Emission From Breakdown; Metal Vapor Jet

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7927

(PARTICLE BEAMS, ION; BREAKDOWN STUDIES)

(Generation; Solid, Optical)

LASER SOURCES FOR MULTIPLY-CHARGED HEAVY IONS

G.F. Tonon

CEA Centre d'Etudes de Linell, Villeneuve-Saint Georges, France

IEEE Transactions On Nuclear Science, Vol. NS-19, No. 2, pp 172-183 (04/1972).

We present a review of the main results concerning the interaction between laser and matter; in particular the results concerning the state of charge, the energy and the spatial distribution of the plasma ions. From these results, we propose to use laser produced plasmas as sources of multiply-charged ions for heavy ion accelerators and we define the laser characteristics which would be required. 70 Refs.

Primary Keywords: Ion Sources; High Ionization; Theory

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(SWITCHES, CLOSING)  
(Vacuum Gaps, Optical)

## LASER TRIGGERED SWITCH STUDY

A.S. Gilmore and R.J. Cline  
Cornell Aeronautical Lab Inc. Buffalo, NY 14221  
RADC Report No. RADC-TR-67-45 (02/1967).  
Availability: AD 818505

NTIS

The feasibility of developing a laser-triggered switch for use in line-type modulator service at a voltage holdoff level of 300 kV and at a conduction current level of 1000 amperes is being investigated. To date, current peaks as high as 2000 amperes have been easily obtained. Using anode arcs (the laser-stimulated emitter at a positive potential with respect to the collector), a delay of approximately one microsecond occurs between the time when the laser illumination impinges on the emitter surface and the time when the maximum switch current occurs. The rise time of the leading edge of the current pulse has been observed to be about 100 nanoseconds, and was limited by the inductance of the external circuitry in experiments performed to date. However, a fast-rise-time ( $t_{sub} \approx 10$  nanoseconds) pulse forming network has been constructed and will be used for future experiments. Pulse-length data indicate that operation in the 1 to 100 microsecond pulse-length range is easily achievable. Emitter life tests have shown that the life of the laser-triggered switch should be in excess of 1000 hours. Static voltage holdoff tests were conducted on the first high-voltage device, which after processing, withstood 300 kilovolts for an extended period. 0 Refs.

Primary Keywords: Vacuum Gap; Multichannel Kilovolt Operation; Fast Rise Time; Cathode Arc; Anode Arc

7931

(SWITCHES, CLOSING)  
(Gas Gaps, Optical)

## LASER-TRIGGERED SPARK GAP

L.L. Steinmetz  
Lawrence Livermore Lab, Livermore, CA 94550  
The Review Of Scientific Instruments, Vol. 39, No. 6, pp 984-989  
(06/1968)

A laser-triggered spark gap (LTSG) was developed to meet the need for producing a kilovolt electrical output pulse that is synchronous with the light output pulse of a Q-switched laser. The LTSG output pulse voltage is variable up to 12 kV, which value makes it usable for actuating Pockel cells. A theoretical explanation of the spark gap's triggering mechanism is developed. 4 Refs.

Primary Keywords: Dye Laser; Coaxial Spark Gap; Low Pressure; Thoriated Tungsten Electrode; Xenon Gap  
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7932

(SWITCHES, CLOSING)  
(Gas Gaps, Optical)

## LASER-TRIGGERED SPARK-GAP SWITCH

A.I. Babalin, B.I. Petrov, V.A. Rodichkin and A.M. Timonin  
Soviet Physics-Technical Physics, Vol. 15, No. 8, pp 1335-1338  
(02/1971)

Trans. From: Zhurnal Tekhnicheskoi Fiziki 40, 1718-1722 (August 1970)  
A spark gap is triggered by the beam from a Q-spooled ruby laser with a power of approximately 25 MW and a pulse length of approximately 30 nsec has been studied. Experimental relations have been found for the trigger time as a function of applied voltage, beam power, and the position of the focal plane of the focusing lens for two interelectrode distances. At a radiation intensity below the threshold for laser breakdown of the gas the best parameters are found when the radiation is focused on the cathode. The smallest trigger time for a gap 16 mm long is 25 nsec with a scatter of  $\pm 3$  nsec. The gap ignites satisfactorily in the range  $(0.25-1.0) U_{sub} \text{ at } U_{sub}$  where  $U_{sub}$  is the static breakdown voltage. 7 Refs.

Primary Keywords: Air Gap; Ruby Laser Delay vs Voltage; Delay vs Beam Power; Delay vs Focal Plane Position  
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7934

(INSULATION, MATERIAL; REVIEWS AND CONFERENCES)  
(Liquid; Reviews)

## AQUEOUS DIELECTRICS

J.B. Hasted  
Birkbeck College, London, UK  
Publishers: Chapman and Hall Ltd., London (01/1973)  
The dielectric constant of water in several of its forms is the subject of this book. Pure water, ice, electrolytic and non-electrolytic solutions, and biomolecules, are all considered with the theory and many graphs and tables presented for each. Both dispersion and loss are addressed. A model is presented for the structure of water and ice. In addition, the dielectric constants of several materials that contain absorbed water are presented. The dielectric properties and conductivity of moist soil, sand, snow, and naturally occurring ice are considered. Breakdown characteristics and electric strength are not addressed. 451 Refs.

Primary Keywords: Water Insulation; Dielectric Constant; Dispersion; Several Solutions In Water; Properties Of Absorbed Water

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7935

(BREAKDOWN STUDIES)  
(Gas, Electrical)

## PECULIARITIES OF THE DEVELOPMENT OF THE ELECTRIC BREAKDOWN OF AIR IN EXTREMELY LONG DISCHARGE GAPS

G.N. Aleksandrov, B.N. Gorin, V.P. Redkov, I.S. Stokol'nikov and A.V. Shkilev  
G.M. Krzhizhanskii Institute, Moscow, USSR  
Soviet Physics-Doklady, Vol. 13, No. 12, pp 1246-1249 (06/1969)  
Trans. From: Doklady Akademii Nauk 558 183, 1048-1051 (December 1968)

The existing experimental data on the electric breakdown of air in long discharge gaps are limited to gaps 1-6 m long. It seemed desirable to undertake an investigation of the phenomenon in longer gaps. This would allow one to determine the tendencies in the modifications of the breakdown development which are associated with an increasing gap length. A knowledge of such tendencies has a considerable practical significance for problems involving the dielectric strength of a P and is of interest for physics in general. This paper gives a brief account of the results of such an investigation, which has been conducted at the M.I. Kalinin Leningrad Polytechnical Institute and at the G.M. Krzhizhanskii Power Institute. 3 Refs.

Primary Keywords: Meter Gap; Atmospheric Air; Breakdown Stages; Flashing Stage; Continuous Leader Stage; Through Stage; Light Emission Measurement; 10 A Currents

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7937

(BREAKDOWN STUDIES)

## REVIEW OF GAS-BREAKDOWN PHENOMENA INDUCED BY HIGH-POWER LASERS-I

I.P. Shkarofsky  
RCA Limited, Quebec, Canada  
RCA Review, Vol. 35, pp 48-78 (03/1974)

This paper discusses the two optical breakdown mechanisms: multiphoton ionization and cascade ionization. The author begins with a short qualitative review of the theory of optical breakdown in gases, and proceeds to describe several experiments performed by several researchers which demonstrate the theory. Attempts are made to explain several anomalies in the results seen. The dependence of breakdown on several factors, such as spot size, impurity level and pulse duration is discussed. Laser maintained discharges are also considered. 71 Refs.

Primary Keywords: Laser Breakdown; Gas Composition; Impurity; Spot Size; Pulse Length; Pressure Dependence  
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7939

(SWITCHES, CLOSING)

(Solid Dielectric, Optical)

## SOLID-DIELECTRIC NANOSECOND SPARK GAP WITH LASER TRIGGERING

A.I. Babalin, V.A. Rodichkin, G.Ya. Rusekov and A.M. Timonin  
Soviet Physics-Technical Physics, Vol. 16, No. 8, pp 1318-1320  
(02/1972)

Trans. From: Zhurnal Tekhnicheskoi Fiziki 41, 1675-1677 (August 1971)  
A solid-dielectric spark gap which is triggered by a Q-spooled ruby laser is described; the unit generates pulses with amplitudes as high as 15-20 kV and lengths of 2-4 nsec with rise times of 0.5-0.7 nsec. The response time of the spark gap is measured as a function of the voltage applied to various types of films with different thickness. The results are discussed. 7 Refs.

Primary Keywords: Ruby Laser; Delay Measurement; Various Dielectric Materials; Variable Thickness  
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7940

(PULSE GENERATORS; SWITCHES, CLOSING)

(Capacitor Banks; Gas Gaps, Optical)

## SOME DESIGN CONSIDERATIONS OF A LASER TRIGGERED IMPULSE GENERATOR

J.J. Babalin and C.G. Morgan  
(12/1965)

Availability:

NTIS  
In a number of Divisions at CERN considerable interest is being taken in the possibility of the production of large current and high voltage impulse generators. This interest arises from requirements, for example, in the MPS and AR Divisions for work on kicker magnets, and in the NPA Division for basic research and development of particle separators. 10 Refs.

Primary Keywords: Review; Vacuum Electrode Emission; Electron Multiplication; Jitter Estimate; Ruby Laser

7941

(BREAKDOWN STUDIES; SWITCHES, CLOSING)

(Gas, Optical; Gas Gaps, Optical)

## SPARK DISCHARGE TRIGGERED BY A PULSE LASER BEAM

K. Horii, T. Noguchi and M. Yano  
Electrotechnical Lab, Tokyo, Japan  
IEEE International Conference On Gas Discharge Proceedings, pp 6-10  
(01/1970)

The spark discharge in an air gap can be triggered by a giant pulse laser beam focused on an electrode surface. This type of gap is called the Laser Triggered Spark Gap, which can meet the need for a high speed switch of heavy current impulse generator. An experimental study of the breakdown mechanism of the gap was performed. 4 Refs.

Primary Keywords: Ruby Laser; Air Gap; Electrode Irradiation; Breakdown Mechanism; Double Current Pulse  
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7943

(PULSE GENERATORS; ELECTROMAGNETIC FIELD GENERATION)

(Capacitive; Magnetic)

## A COMPACT MAGNETIC-FIELD-PULSE GENERATOR

I.I. Ushekov  
Leningrad Technological Institute, Leningrad, USSR  
Instruments And Experimental Techniques, Vol. 16, No. 6, pp 1797-1799  
(12/1973)

Trans. From: Pribury i Tekhnika Eksperimenta 6, 154-156  
(November-December 1973)  
A simple device is described which generates monopolar magnetic field pulses having a density ranging from 4 to 2.5 MA/cm for a discharge-current amplitude ranging from 4 A to 2.5 kA. The repetition frequency of the pulses may be controlled in the range from 25 to 0.5 Hz. The possibility is provided for the operation of the generator in a one-shot mode. The length of the magnetic field pulses at the base is approximately 160 microseconds; the discharge energy of the capacitor bank is  $\leq 200$  J. The stability of the amplitudes of the current and magnetic-field pulses is  $\pm 0.05\%$ . 7 Refs.

Primary Keywords: Pulse Generator; 4 A - 2.5 kA Current Range; 2.5 MA/cm Field; Thyristor; Crowder

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7948

(BREAKDOWN STUDIES; SWITCHES, CLOSING)

(Gas Optical; Gas Gaps, Optical)

TIME CONSTANTS OF SPARK DISCHARGES INITIATED BY A GAS-LASER BEAM OF  $\lambda = 0.3371$  MICRONSYu.A. Kurbatov and V.F. Tarasenko  
Soviet Journal Of Quantum Electronics, Vol. 2, No. 6, pp 567-568  
(06/1975)

Trans. From: Kvantovaya Elektronika 12, 108-109 (1972)  
An investigation was made of the time constants of spark discharges initiated by a laser beam of  $\lambda = 0.3371$  microns and 10 kW peak power. The experiments were carried out at pressures of 1-10 mm in a discharge chamber. The discharge gap was 1-10 mm and the applied voltage was 10-200 kV. The laser beam was directed onto a copper cathode through a grid-like anode. The discharge delay time varied depending on the conditions, from 1 to 100 nsec. The fluctuations of the delay time did not exceed  $\pm 3$  nsec even at voltages close to the static breakdown value. This high stability of the triggering of the discharge gaps indicated that the laser beam in question was a suitable source for initiation of high-power spark discharges. 4 Refs.

Primary Keywords: Nitrogen Laser; Variable Pressure; Variable Gap Spacing; Copper Electrode; Delay Measurement; Jitter Measurement

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7951

(SWITCHES, CLOSING)  
(Gas Gaps, Optical)

## 12.2-LASER-TRIGGERED MEGAVOLT SWITCHING

A.M. Guenther and J.R. Bettis

AFML, Kirtland AFB, NM 87117

IEEE Journal Of Quantum Electronics, Vol. QE-3, No. 11, pp 581-588  
(11/1967).

Laser-initiated breakdown of high-voltage spark gaps has been extended to the megavolt range through the use of a novel coaxial triggering geometry. In this configuration, a 100- to 250-megawatt ruby laser of 1.4- to 3.5-joules output was aligned along the interelectrode axis of the spark gap. The laser beam passed through a hemispherical electrode, mounted on a hollow shaft, and was focused by a lens internal to this electrode at the opposite-switch electrode surface. Based on investigations of the effect of polarity on switch performance, i.e., least delay and jitter, it was concluded that 1) irradiation of the charged electrode was preferred and 2) irradiation of positive- rather than negative-charged electrodes gave best performance. Delay times between arrival of the laser pulse and complete gap closure as short as 2 ns with unmeasurable jitter ( $< 1$  ns) were readily attainable under various conditions (high-pressure and high-reduced fields). By recourse to classical arc breakdown theories, i.e., Townsend avalanche and streamer mechanism, it was concluded that the variation of delay with reduced field follows an avalanche process. However, for an explanation of extremely short delays observed (high-velocity closure rates), a streamer mechanism is necessary. 15 Refs.

Primary Keywords: Ruby Laser; Air Gap; Nitrogen Gap; Megavolt; Operating Voltage; Single-channel Discharge; Experiment; Theory

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7966

(BREAKDOWN STUDIES)

(Vacuum, Electrical)

## FIELD EMISSION: LARGE CURRENT DENSITIES, SPACE CHARGE, AND THE VACUUM ARC

M.P. Dyke and J.K. Trolan

Linfield College, McMinnville, OR

Physical Review, Vol. 89, No. 4, pp 799-808 (02/1953).

Field emission was obtained from a single crystal tungsten emitter under conditions of very high vacuum and clean surfaces. The geometry of the emitter was determined by electron microscopy permitting accurate calculation of both the surface electric field and an average current density. The use of pulse electronic techniques extended the observations to the upper limit of the current densities for which the normal field emission was stable. Above this limit an explosive vacuum arc occurred between electrodes. From these experiments the following conclusions were drawn: (1) The wave mechanical image force corrected theory quantitatively predicted the observed average current density up to that density of the order of 127 amperes/cm<sup>2</sup>, where a marked deviation occurred from the usual current-voltage relationship. (2) Space charge effects permitted the simultaneous operation of multiple emitting areas of differing geometries. (3) At a still higher critical current density in the range to 128 amperes/cm<sup>2</sup>, a field emission initiated vacuum arc occurred between electrodes resulting in a change of emitter geometry. Current density was the dominant criterion for the initiation of the vacuum arc. 25 Refs.

Primary Keywords: Field Emission; Tungsten Cathode; Clean Surface; Surface E-field; Emission vs Voltage; Vacuum Arc

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7971

(BREAKDOWN STUDIES; SWITCHES, CLOSING)

(Vacuum, Electrical; Vacuum Gaps, Electrical)

## INITIAL STAGES OF LOW-PRESSURE PULSE DISCHARGE

A.B. Boie and E.M. Reinhrud

Moscow State University, Moscow, USSR

Soviet Physics-Technical Physics, Vol. 6, No. 9, pp 821-826 (03/1962).

Trans. From: Zhurnal Tekhnicheskoi Fiziki 31, 1127-1134 (September 1961).

A study was made of the ignition of a pulse discharge in a tube containing a cold cathode with a trigger electrode at initial pressures 1E-4 - 1E-6 mm Hg and initial voltages 30-60 kV. A study of the current and voltage variation with time by oscillography and simultaneous measurement of the integral intensity of the x-ray emission of the discharge showed that ignition of the pulse discharge passes through a stage of predischARGE pulses prior to the stage of the gas-focused beam. The lifetime ( $\tau_{\text{sub}}/2$ ) of the predischARGE pulse stage with fixed initial conditions (capacitance and initial voltage of pulse generator, degree of outgassing of electrodes, pressure) depends on the emissive properties of the cold cathode;  $\tau_{\text{sub}}/2$  can be prolonged from one microsecond to several milliseconds by variation of the resistance ( $R_{\text{sub}}/2$ ) in the trigger-gap circuit. The investigated prolongation of ignition can be used for control of the duration ( $\tau$ ) of the electron-optical stage, which includes the above-mentioned stages, of the pulse discharge. 9 Refs.

Primary Keywords: Vacuum Breakdown; Cold Cathode; Trigger Electrode; 1E-6 Torr Pressure; 60 kV Voltage; Current Measurement; Voltage Measurement; Temporal Resolution

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7974

(SWITCHES, CLOSING)

(Vacuum Gaps, Electrical)

## LOW VOLTAGE FIRING CHARACTERISTICS OF A TRIGGERED VACUUM GAP

G.A. Farrall

General Electric Co., Schenectady, NY 12301

IEEE Transactions On Electron Devices, Vol. ED-13, No. 4, pp 432-438  
(04/1966).

The triggered vacuum gap is a normally nonconducting device in which a high-current metal-vapor arc can be established by a suitable pulse of current to a triggering electrode. While this gap is well suited to switching applications at high voltage, it has properties which make it useful at low voltage as well. The operation of the triggered vacuum gap has, therefore, been studied in the range of 100 to 1000 volts. It was found that, although the gap could be triggered with currents as low as 0.02 amperes, consistent triggering with firing delays less than a microsecond required trigger pulses of 10 amperes or more. Little or no dependence of firing time on main gap voltage was observed. Below a few hundred volts, however, the probability of establishing a stable main discharge with a short duration trigger pulse falls off rapidly with decreasing gap voltage. The polarity of the main gap voltage and of the trigger pulse strongly influenced the firing characteristics of the gap in the range studied. These effects are discussed in detail. 11 Refs.

Primary Keywords: Vacuum Spark Gap; Metal Vapor Arc; 100-1000 V; Operating Voltage; Very Low Trigger Current; Delay Measurement; Jitter Measurement

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7976

(BREAKDOWN STUDIES)

(Surface Flashover)

## NANOSECOND TIME DEVELOPMENT OF A PULSED DISCHARGE AT A DIELECTRIC-VACUUM INTERFACE

S.P. Bugaev and G.A. Mevets

Tomsk Polytechnic Institute, Tomsk, USSR

Soviet Physics-Technical Physics, Vol. 10, No. 7, pp 930-932 (01/1966).

Trans. From: Zhurnal Tekhnicheskoi Fiziki 35, 1292-1294 (July 1965).

The time development of a discharge at a dielectric-vacuum interface must be studied to clarify the mechanism underlying the phenomenon and to facilitate the selection of vacuum insulation, the development of switching devices, electron tubes, etc. Breakdown at the surface of a dielectric in vacuum has not been studied adequately to date. The effect of various factors on breakdown voltage has been investigated previously, prebreakdown currents have also been studied, and the voltage-time characteristic have been studied in the microsecond range. However, the literature contains no information on the time required for breakdown to develop over a dielectric-vacuum interface so that it is difficult to explain the processes taking place during breakdown. 7 Refs.

Primary Keywords: Surface Flashover; Vacuum Environment; Flashover Voltage; Flashover Delay; Several Dielectrics; Sample Conditioning

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8000

(BREAKDOWN STUDIES)

(Vacuum, Electrical)

## THE INITIATION OF ELECTRICAL BREAKDOWN IN VACUUM

L. Cranberg

Los Alamos National Labs, Los Alamos, NM 87545

Journal Of Applied Physics, Vol. 23, No. 5, pp 518-522 (05/1952).

The hypothesis is suggested that initiation of high voltage breakdown in vacuum is due to traversal of the high voltage gap by a clump of loosely adhering material. The implication of this hypothesis for uniform-field gaps is that the breakdown voltage is proportional to the square root of the gap length. A summary of the literature is presented which supports this conclusion for a range of gap distance from 0.2 mm to 6 meters. Additional qualitative evidence is presented which tends to support the proposed hypothesis. 15 Refs.

Primary Keywords: Vacuum Breakdown; Uniform Field; Microparticle; Breakdown Voltage vs Gap Spacing; Square Root Dependence; Literature Review

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8009

(SWITCHES, CLOSING)

(Gas Gaps, Optical)

## INVESTIGATION OF LASER PULSE FORMING BY LTSG AND POCKELS CELLS

K. Yoshida, I. Yamane, S. Sasaki, K. Shimamura and C. Yamanaka

Osaka University, Suita, Osaka, Japan

Electrical Engineering In Japan, Vol. 92, No. 6, pp 117-122 (11/1972).

Trans. From: Denki Gakkai Ronbunshi 92C, 377-383 (November 1972).

This paper describes a laser-triggered gas gap used to switch a Pockels Cell for laser light switching. The gap is filled with an argon-nitrogen mixture with the laser focused on the cathode. Electrodes are stainless steel. The gap distance is adjustable. Graphs of delay vs. self-breakdown voltage, delay vs. electrode spacing, and rise time vs. electrode spacing are presented. 24 Refs.

Primary Keywords: Glass Laser; Argon Gap; Nitrogen Gap; Stainless Steel Electrode

8011

(BREAKDOWN STUDIES)

(Gas, Electrical)

## SOME PROPERTIES OF HIGH CURRENT SPARK CHANNELS

C. Braudo and J.D. Craggs

University of Liverpool, Liverpool, UK

International Journal Of Electronics, Vol. 22, No. 4, pp 329-353  
(06/1967).

Spark channels carrying currents of 200 kA were studied in hydrogen, argon, and helium at 760 Torr. Measurements were taken of the gap voltage drop, the gap resistance, the channel expansion velocities, and the current waveform. Other spark channel characteristics, such as shock wave velocity, pinch temperature, drift velocity, ion and electron density, and channel resistance, are then calculated from the results. 26 Refs.

Primary Keywords: Spark Channel; High Current; Voltage Drop; Expansion Rate; Discharge Temperature

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F043

(BREAKDOWN STUDIES)

(Gas, Electrical)

## DEVELOPMENT OF ELECTRON AVALANCHES AND STREAMERS

E.D. Lozanskii

Soviet Physics Usp. Vol. 18, No. 11, pp 893-908 (11/1975).

Trans. From: Usp. Fiz. Nauk 117, 493-521 (November 1975).

The article presents a review of the current state of the theory of avalanche-streamer processes, i.e., processes occurring during the development of discharges in dense gases. The principal attention is devoted to description of the physical picture of the phenomena. A systematic presentation is given of the theory of the main stages of formation of a discharge: the theory of electron avalanches, the theory of a self-maintaining discharge, the theory of the avalanche-streamer transition, and the theory of streamers. The question of breakdown of long spark gaps is discussed briefly. 126 Refs.

Primary Keywords: Review; Theory; Dense Gas; Discharge; Physical Picture; Self-maintaining

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8844  
(BREAKDOWN STUDIES)  
(Gas, Optical)  
EFFECT OF HIGH MAGNETIC FIELDS ON THE THRESHOLD OF LASER-INDUCED GAS BREAKDOWN

E.J. Button and A.H. Quentner  
AFML, Kirtland AFB, NM 87117  
Journal Of Applied Physics, Vol. 47, No. 2, pp 522-530 (02/1976).  
A quantum rate analysis of laser-induced breakdown in deuterium and helium gas was used to predict the dependence of the breakdown-threshold intensity on gas pressure, laser-pulse length, and the magnitude of an applied external magnetic field parallel to the direction of propagation of the laser beam. Diffusion, elastic and inelastic collisions, and multiphoton ionization of atomic and molecular states excited by electron impact were considered. The threshold data indicate the presence of three distinct regions: the pulse-length dominated, intermediate, and the diffusion dominated, as well as the importance of a dimensionless parameter  $\omega\tau$  in determining the magnitude of the magnetic field effect on the breakdown threshold for a given set of experimental conditions. The results are in excellent agreement with experimental data. 36 Refs.  
Primary Keywords: Laser-Induced Breakdown; Helium; Threshold Intensity; Parallel Magnetic Field; Numerical Calculation; Experiment  
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8845  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
LOCALIZATION OF FIELD EMISSION IN SMALL SOLID ANGLES

G.M. Fursai and S.A. Shakhrova  
A.A. Zhdanov Leningrad State University, Leningrad, USSR  
Soviet Physics Technical Physics, Vol. 11, No. 6, pp 827-832 (12/1966).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 36, 1125-1131 (June 1966).  
A field-emission cathode is a point source of electrons with very small linear dimensions (0.01 to 1 micron). This makes it possible to focus the electron beam by direct electron-optical methods and to simplify electron-optical systems significantly. These sources, however, exhibit spherical symmetry with a radially diverging beam. Thus, the aperture angle of the emitted cone is very large. For average emission densities ( $1E4-1E5$  A/sq.cm.) approximately equal to 60 Deg. and, for the limiting densities ( $1E7-1E8$  A/sq.cm.), approximately equal to 100 Deg. In order to obtain a fine electron probe a very narrow pencil is usually isolated from the beam. The apertures for emission of the minimum permissible aberrations in the beam are to  $1E-3-1E-2$  rad. 17 Refs.  
Primary Keywords: Field-Emission Diode; Large Divergence; Collimating Aperture; High Losses; Selective Electron Emission  
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8846  
(PARTICLE BEAMS, ION)  
(Generation)  
PARTICLE ACCELERATION BY COLLECTIVE EFFECTS

D. Keefe  
Lawrence Berkeley Lab, Berkeley CA  
1976 Proton Linear Accelerator Conference, pp 352-357 (09/1976).  
Successful acceleration of protons and other ions has been achieved experimentally in this decade by a number of different collective methods. The attainment of very high accelerating fields has been established although so far the acceleration distance has been confined to only a few centimeters. Efforts are in progress to understand the accelerating mechanisms in detail and, as a result, to devise ways of extending considerably the acceleration distance. This paper is intended to review the current progress, expectations, and limitations of the different approaches. 20 Refs.  
Primary Keywords: Proton Acceleration; Ion Acceleration; Collective Effects; Review  
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8847  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
PHOTOPREIONIZATION OF THE 3371-ANGSTROM PULSED N/SUB 2/ LASER  
M.A. Kurnit, K. Bishchik, L.M. Ryan Jr., A. Javan and S.J. Tubbs  
Massachusetts Institute of Technology, Cambridge, MA  
IEEE Journal Of Quantum Electronics, no 174-176 (04/1975).  
Photopreionization of the 3371-angstrom pulsed N/sub 2/ laser by use of a seed gas of low ionization threshold and flashlamp excitation is observed to result in increased laser output and reproducibility. Preionization also increases the range of permissible operating pressures, enabling operation with atmospheric-pressure mixtures of N/sub 2/ and He without reduced intensity. 8 Refs.  
Primary Keywords: Photoionization; Flashlamp; Arc Suppression; Large Volume  
Secondary Keywords: Nitrogen Laser Pumping  
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8849  
(PULSE GENERATORS; SWITCHES, CLOSING)  
(Systems: Gas Gaps, Electrical)  
SUBNANOSECOND RISETIME MULTIKILOVOLT PULSE GENERATOR

D.F. McDonald (1), C.J. Benning (1) and S.J. Brient (2)  
(1) BDM Corp., El Paso, TX  
(2) University of Texas at El Paso, TX  
The Review Of Scientific Instruments, Vol. 36, No. 4, pp 504-505 (04/1965).  
A multikilovolt nanosecond pulse generator has been developed which uses a new approach to the design of an extremely fast gas-discharge switch. The design concept is based on the statistical time lag which precedes an electrical breakdown. The generator also employs large coaxial geometry so that extremely high operating voltages may be used. A description of instrumentation required to measure the fast rise time, high voltage pulses is included along with some typical oscilloscope traces. 8 Refs.  
Primary Keywords: Fast Rise; High Pressure Spark Gap; Pulse Forming Line; Statistical Time Lag  
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8850  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
CHARACTERISTICS OF THE TRIGATRON SPARK-GAP

A.M. Sletten and T.J. Lewis  
Queen Mary College, London, UK  
Proceedings of the IEE, Vol. 104, Pt. C, No. 5, pp 54-61 (03/1957).  
The behaviour of a trigatron three-electrode spark-gap in air has been investigated and its characteristics obtained with particular reference to its use as a controlled high-voltage switch. It is found that the voltage range over which it may be triggered satisfactorily depends, not only on the polarities of the main gap and triggering voltages, but also on the energy of the discharge. The breakdown time-lag is also determined by these same voltage polarities and also by the time-constant of the trigger discharge circuit. From these characteristics and certain other relevant observations, a theory of the breakdown process in such a spark-gap is suggested, involving the propagation from the trigger of a low-density easily-ionized region. Finally, a brief investigation of the successful use of a trigatron in a diverter circuit capable of diverting the discharge energy in a spark-gap subjected to direct and impulse voltages of 300 kV and in a circuit providing accurate 'chopping' of impulse voltage waves, is reported. 12 Refs.  
Primary Keywords: Trigonon; Air Gap; Operating Characteristics; Voltage Operating Range; Trigger Polarity Dependence  
COPYRIGHT: 1956 IEE

8851  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
THE CHARACTERISTICS OF THE TRIGATRON SPARK-GAP AT VERY HIGH VOLTAGES

T.E. Broadbent  
University of Manchester, Manchester, UK  
IEE Monograph No. 364 M, pp 213-215 (03/1960).  
Curves are given showing the working range and time-lag characteristics of a trigatron spark-gap working in air at voltages up to 1 MV. It is shown that, for voltages of this magnitude, a single-stage trigatron spark-gap of suitable design provides a simple and convenient method of chopping the voltage at any required instant. Factors which affect the performance of the gap are discussed. 7 Refs.  
Primary Keywords: Trigonon; Operating Characteristics; Time Lag; Voltage Range; Air Gap; Geometry Dependence  
COPYRIGHT: 1960 IEE

8852  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
THE DEVELOPMENT OF THE DISCHARGE IN THE TRIGATRON SPARK GAP AT VERY HIGH VOLTAGES

T.E. Broadbent and A.H.A. Shloush  
University of Manchester, Manchester, UK  
British Journal Of Applied Physics, Vol. 14, pp 687-691 (06/1963).  
The optical phenomena occurring during the initiation of breakdown in the trigatron spark gap in air have been investigated with voltages up to 1 MV and inter-electrode spacings up to 60 cm, using an image converter as an electro-optical shutter. Measurements of gap current flowing during the breakdown initiation process have also been made. The optical phenomena are similar in nature to those occurring in long untriggered gaps. One or more leader strokes occur, followed by a main stroke. Leader stroke velocities fall within the range 5E6 to 3.2E8 cm/sec depending on experimental conditions. The average mainstroke velocity is about 1E8 to 1E9 cm/sec. Under certain conditions the path taken by the complete spark is partly governed by the production of a short leader stroke originating at one electrode. It is shown that this leader occurs only in the region of the gap where conditions laid down by Loeb and Meek and Reuther as being suitable for streamer formation and propagation are satisfied. 10 Refs.  
Primary Keywords: Trigonon; Optical Observation; Gap Current Measurement; Leader Stroke; Main Stroke; Discharge Propagation Speed  
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8861  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
ELECTRON EMISSION AT HIGH FIELDS DUE TO POSITIVE IONS

P. Viskul  
Bell Labs, Murray Hill, NJ 07974  
Journal Of Applied Physics, Vol. 30, No. 1, pp 51-55 (01/1959).  
Two mechanisms have been proposed to account for the observed large yield of secondary electrons in gaseous breakdown at high electric fields. In one of these a single ion in approaching the cathode surface creates a 'pass' by decreasing the width of the potential barrier. In the other the increased over-all fields due to a large number of ions in the gap is supposed to account for the increased emission. The first effect is reexamined and appears to be effective in the observed breakdowns of extremely small gaps in air. It may also be effective in breakdown at high pressure and in liquid and solid dielectrics. 21 Refs.  
Primary Keywords: Gas Breakdown; High-field Breakdown; Secondary Emission; Cathode Effect; Potential Barrier Decrease; Ionic Field Increase  
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8863  
(BREAKDOWN STUDIES)  
(Electrodes)  
FIELD-DEPENDENT SECONDARY EMISSION

H. Jacobs  
ECOM, Fort Monmouth, NJ 07703  
Physical Review, Vol. 84, No. 3, pp 877-884 (12/1951).  
Experiments have been conducted with magnesium oxide surfaces in which high DC fields were applied to the surface, while at the same time secondary emission measurements were being made. Very high secondary emission ratios were obtained reproducibly (100 to 1 and greater). Under static conditions it was found that the ratios would increase exponentially with increasing fields. In addition, for constant fields, the ratio of liberated electrons to bombarding electrons was constant, over a wide range of bombardment energy. Measurements were made of secondary emission with a square wave field applied to the surface and time lag effects were noted. Decay time in the order of 30 microseconds were measured. The rise time was found to be dependent upon field and bombardment currents. The mechanism of field dependent secondary emission was shown to be related to an avalanche effect, triggered by the bombarding electrons. 12 Refs.  
Primary Keywords: Electron Emission; Secondary Emission; Magnesium Oxide Surface; High Secondary Emission; Exponential Variation With Field  
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8090  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
WHISKER GROWTH IN HIGH-VOLTAGE HIGH-VACUUM GAPS  
L. Jedynek  
University of Wisconsin, Madison, WI  
Journal Of Applied Physics, Vol. 36, No. 6, pp 2587-2589 (06/1965).  
The verification by Little and Whitney of the existence of whisker-like microprojections on the cathode electrode of a vacuum gap offers strong support for the field-emission-initiated and clump theories of vacuum breakdown. The cathode whiskers correlate well with the electron beam discussions of Maitland and also match Dyke's description of breakdown due to vaporization of a field-emitting point. The clump theory and time lag of breakdown are both describable in terms of microprojections as done by Denholm in his article on growth and fracture of points in the vacuum gap. The existence of the microprojections, or whiskers, supports the present belief that breakdown does not have a single primary cause, but is instead caused by any one of several mechanisms depending upon the local conditions existing within the gap. 8 Refs.  
Primary Keywords: High-vacuum Gaps; Vacuum Breakdown; Cathode Whiskers; Clump Theory; Prebreakdown Current  
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8091  
(BREAKDOWN STUDIES)  
(Gas, Optical)  
CHANNELING OF AN IONIZING ELECTRICAL STREAMER BY A LASER BEAM  
D.W. Koopman and T.D. Wilkerson  
Versar Inc. Springfield, VA 22151  
Journal Of Applied Physics, Vol. 42, No. 5, pp 1883-1886 (04/1971).  
Long electrical spark discharges have been directed through air along predetermined paths defined by a concentrated laser beam. At apparent optical power densities of 50-100 GW/sq.cm., 35-nsec half-width laser pulses at 10.6 microns have been effective in channeling streamer discharges from a 350-kV positively charged electrode for distances up to 28 cm in a total streamer length of 71 cm. The average E-field required to obtain a discharge between electrodes was reduced from 7.3 to 5.5 kV/cm with the laser power employed. 12 Refs.  
Primary Keywords: Laser Channeling; Directed Discharge; Long Distances; Low Level Ionization By Laser  
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8093  
(PARTICLE BEAMS, ELECTRON)  
(Reviews)  
ELECTRON BEAM FUSION PROGRESS REPORT OCTOBER 1976 THROUGH MARCH 1977  
Authors Unknown  
Sandia Labs, Albuquerque, NM 87115  
Sandia Report No. SAND77-1414 (10/1977).  
Availability: SAND77-1414  
NTIS  
This report provides an overview of the progress made on the electron beam fusion program from October 1976 through March 1977 at Sandia Laboratories. The authors begin with a review of the concept of the EBFA and proceed to briefly discuss the progress made and problems encountered in the development of vacuum insulation systems, Marx generators, intermediate energy stores, switches, and diode construction. Predicted target interactions and projected diagnostic are also discussed. 126 Refs.  
Primary Keywords: Electron Beam Fusion; Magnetic Insulation; Marx Generator; Trigratron; Vacuum Diode; Vacuum Flashover  
Secondary Keywords: Diagnostics

8094  
(POWER CONDITIONING)  
(Saturable Reactors)  
MAGNETIC SWITCHES AND CIRCUITS  
M.C. Munnally  
Los Alamos National Labs, Los Alamos, NM 87545  
Los Alamos Report No. LA-8862-MS (09/1981).  
This report outlines the use of saturable inductors as switches in lumped-element, magnetic-pulse compression circuits. The operation of the three basic types of magnetic pulse compression circuits is discussed and the characteristic use of each is defined. In addition, the geometric constraints and magnetic pulse compression circuits used in short-pulse, low-inductance systems are considered. The scaling of presaturation leakage currents, magnetic energy losses, and switching times with geometrical and material parameters are developed to aid in evaluating magnetic pulse compression systems in a particular application. Finally, a scheme for increasing the coupling coefficient in saturable stripline transformers is proposed to enable their use in the short-pulse, high-voltage regime. 8 Refs.  
Primary Keywords: Pulse Compression; Saturable Inductor; Lumped Element; Switching Characteristics; Design Considerations

8095  
(ELECTROMAGNETIC LAUNCHERS)  
(Railguns)  
RESULTS OF RAILGUN EXPERIMENTS POWERED BY MAGNETIC FLUX COMPRESSION GENERATORS  
R.S. Hauke (1), A.L. Brooks (1), F.J. Deadrick (1), J.K. Scudder (1), C.M. Fowler (2), R.S. Caird (2) and D.R. Peterson (2)  
(1) Lawrence Livermore Lab, Livermore, CA 94550  
(2) Los Alamos National Labs, Los Alamos, NM 87545  
UCRL Report No. UCRL-84875 (10/1980).  
Availability: UCRL-84875  
NTIS  
Researchers from LLNL and LANSL initiated a joint railgun research and development program to explore the potential of electromagnetic railguns to accelerate projectiles to hypervelocities. The effort was intended to: 1) determine experimentally the limits of railgun operation; 2) verify calculations of railgun performance; and 3) establish a data base at megampere currents. The program has led to: 1) the selection of a particular magnetic flux compression generator (MFCG) design for a set of initial experiments and 2) the design of small- and large-square bore railguns to match the expected MFCG power profile. The bore sizes are 12.7 and 50 mm, respectively. In this paper, we briefly describe the design of the railguns and the diagnostic and data reduction techniques, followed by the results of eight experiments with the two railgun types. 8 Refs.  
Primary Keywords: Theory; Experiment; Numerical Calculation; Flux Compression Generator; Railgun Design Consideration

8087  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
SURGE VOLTAGE BREAKDOWN OF AIR IN A NONUNIFORM FIELD  
J.H. Park and H.N. Cones  
Journal Of Research Of The National Bureau Of Standards, Vol. 56, No. 4, pp 201-224 (04/1956).  
The discharge and breakdown phenomena in air when a surge voltage is applied to sphere-plane electrodes were investigated. A steeply rising surge of 145 kilovolts peak value was applied to the plane placed 86 centimeters above the laboratory floor. A 1.6 centimeter diameter sphere, mounted on adjustable distance below the plane, was connected to ground through the surge impedance of a coaxial cable. Experimental data consisted of oscillograms of the current to the sphere and pictures of the discharge between the electrodes. A method for chopping the applied voltage surge at an accurately controllable time was used to study the discharge at gap spacings for which a full-wave applied surge would cause breakdown. 17 Refs.  
Primary Keywords: Pulsed Voltage; Sphere-plane Electrodes; Variable Gap Spacing; Variable Pressure; Current Waveform

8088  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Gas, Optical; Gas Gaps, Optical)  
OPTICALLY-INITIATED DIRECTED ELECTRIC BREAKDOWN IN A GAS  
A.G. Akmanov, L.A. Rivlin and V.S. Shil'dyayev  
Soviet Physics JETP Letters, Vol. 8, No. 8, pp 258-259 (10/1968).  
Trans. From: ZhETF Pisma V Redaktsiyu 8, 417-419 (October 1968).  
The advancement in generation of intense coherent ultraviolet radiation uncover a possibility of observing plasma traces of an ultraviolet beam in a gas and various associated electric phenomena. These include in first order a directional electric breakdown along a prolonged ionized channel (plasma column), and also reflection of light waves from the column or their propagation along the column. It is known that analogous phenomena are observed in optical breakdown of a gas by laser radiation in the infrared or visible band at high optical energy density (approximately 1E5 JW/sq.cm.). An increase of the light frequency (up to the ultraviolet), which increases the photoionization probability, should lead to an appreciable lowering of the necessary energy density and to a possibility of experimentally separating these phenomena from optical breakdown. 8 Refs.  
Primary Keywords: Ultraviolet Radiation; Optically Directed; Breakdown; Low Power Density; Theory  
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8089  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
THE REIGNITION VOLTAGE CHARACTERISTICS OF FREELY RECOVERING ARCS  
F.W. Crawford (1) and M. Edels (2)  
(1) College Of Advanced Technology, Birmingham  
(2) University Of Liverpool, Liverpool, UK  
IEE Paper No. 3155 S (04/1960).  
The recovery characteristics of an arc are studied in this paper. The authors consider a pulsed discharge in air, nitrogen, argon and hydrogen with carbon electrodes. Current is interrupted by external means, and a second pulse of variable voltage and delay is applied. In this way, the reignition voltage of the arc can be determined as a function of time. Currents considered are from 10 to 50 A with pressures between 10<sup>-2</sup> to 10<sup>-1</sup> Torr and gap distances of 1-5 mm. Full gap recovery is seen to require a current interruption of about 1 sec. The process is found to closely follow the extended Paschen Law. 16 Refs.  
Primary Keywords: Arc Recovery Time; Restrike Voltage; Temporal Resolution; Recovery Pause Horizontal Arc; Vertical Arc  
COPYRIGHT: 1960 IEE

8096  
(ELECTROMAGNETIC LAUNCHERS)  
(Railguns)  
RAILGUN ACCELERATORS FOR GRAM-SIZED PROJECTILES  
R.S. Hauke  
Lawrence Livermore Lab, Livermore, CA 94550  
UCRL Report No. UCRL-84623 (10/1980).  
Availability: UCRL-84623  
NTIS  
In this paper, we describe the operation and critical parameters of railguns, we compare the potential and actual performance with other types of microparticle accelerators, and we discuss their research and industrial applications. Railgun accelerators have the potential to accelerate massive projectiles to very high velocities in very short distances. Recent research has demonstrated the usefulness of railguns for research and industrial applications. The railgun accelerator is essentially a linear DC motor consisting of a pair of rigid parallel conductors that carry current to and from an interconnecting movable conductor. The connecting link functions as an armature, and the parallel rails serve as a single-turn field winding. The resulting Lorentz force on the armature is proportional to the square of the current. A 1-MA current will produce about 2E5 N of thrust. A one-gram projectile will experience an acceleration of 2E8 m/s<sup>2</sup> and in one meter achieve a velocity of 20 km/s. Conventional projectiles are limited to launch velocities of the order of 10 km/s. Hence railguns will enable research and applications at previously unattainable velocities. Velocities in excess of 10 km/s will lead to new research at high pressure and high-energy density. Behavior of matter in the 1-10 TPa or perhaps 1E3 TPa range will provide valuable insight to terrestrial and extraterrestrial phenomena. 14 Refs.  
Primary Keywords: Small Projectiles; Operating Parameters; Tutorial Overview

8091  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES)  
(Gas, Electrical; Gas, Optical)  
CW GAS BREAKDOWN IN ARGON USING 10.6-MICROM LASER RADIATION  
D.L. Franzen  
National Bureau Of Standards, Boulder, CO 80502  
Applied Physics Letters, Vol. 21, No. 2, pp 62-64 (07/1972).  
A very intense gas breakdown spark has been extended to a continuous arc in argon using a focused cw CO/sub 2/ laser. To achieve cw breakdown, the focal volume of a mirror focusing a high-power CO/sub 2/ laser was preionized by a single pulse from a CO/sub 2/ TEA laser. The electron density created by the pulsed laser is sufficient to start the cw plasma. This letter reports accurate measurements of pulsed thresholds as well as preionized cw thresholds for breakdown in argon. Also, a study of the time development of the cw plasma is presented. 5 Refs.  
Primary Keywords: CO/sub 2/ Laser; Argon Gas; Laser Sustained Discharge; Ionizing Threshold; Sustaining Threshold  
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8092  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES)  
(Gas, Electrical; Gas, Optical)  
EFFECTS OF CW POWER ON THE PULSED GAS BREAKDOWN THRESHOLD IN ARGON AT 10.6-MICRON RADIATION  
C.D. Moody  
Army Missile Command, Redstone Arsenal, AL 35899  
Applied Physics Letters, Vol. 22, No. 1, pp 31-32 (01/1973).  
When the focussed beams of a pulsed CO/sub 2/ laser and a cw CO/sub 2/ laser were superimposed, the pulsed gas breakdown threshold was raised. It was found that the increase in the threshold was dependent on the gas pressure and cw power. When the intensities obtained with different focal diameters were compared, it was found that the cw gas breakdown threshold has a 1/y<sup>2</sup> dependence on the radius of the focussed cw power spot. 3 Refs.  
Primary Keywords: CO/sub 2/ Laser; Argon Gas; CW Laser; Pulsed Laser; Superimposition Of Beams  
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8093  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES)  
(Gas, Electrical; Gas, Optical)  
SIMILARITY BETWEEN PHYSICAL PROCESSES IN A PULSED DISCHARGE AND IN THE EFFECT OF LASER RADIATION ON A METAL  
L.I. Grachikhin and L.Ya. Min'ko  
Institute Of Physics, Academy Of Sciences Of The BSSR, Minsk  
Soviet Physics-Technical Physics, Vol. 12, No. 6, pp 846-849 (12/1967).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 37, 1169-1172 (June 1967)  
High-current pulsed discharge and concentrated laser radiation on a metal both provide strong heat sources which are comparable in magnitude (approximately 1E4-1E8 W/sq.cm.) and which erode the surface of a metal. In this connection it is of interest to consider general physical processes taking place on the surface of a metal and in the resulting plasmas and to use this as a basis to explain some specific properties of each source. Detailed studies were made of the physical processes associated with the disintegrating effect of concentrated laser radiation on a metal. Experiments were performed using a neodymium laser which provided an energy density of 1E4-1E8 W/sq.cm.; this is equivalent to densities realized in high-current pulsed discharges. 11 Refs.  
Primary Keywords: Laser Erosion Of Metal; Pulsed Electrical Discharge; Plasma Jet; Light Emission Measurement; Dark Space  
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8095  
(SWITCHES, CLOSING)  
(LASS)  
HIGH-POWER SWITCHING WITH PICOSECOND PRECISION  
G. Mourou and M. Knox  
University Of Rochester, Rochester, NY 14623  
Applied Physics Letters, Vol. 35, No. 7, pp 492-495 (10/1979).  
Up to 10 kV have been switched with Si and GaAs laser-activated switches. We show that in spite of the thermal instability shortcoming experienced in Si, quasi-DC bias operation can be utilized in a manner which relaxes stringent synchronization requirements. In the case of GaAs the thermal instability is less severe and up to 8 kV DC has been held off and efficiently switched. In both cases, a fast switching time of approximately 40 ps is observed. This time is a combination of the laser pulse width, geometry bandwidth, and jitter time. Efficient switching action requires only a few tens of microjoules of laser energy. Electrical pulses ranging from subnanosecond to hundreds of nanoseconds duration have been readily generated. 6 Refs.  
Primary Keywords: Silicon Switch; Light Activated; Thermal Instability; Quasi-DC Bias; 40 ps Switching Time  
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8098  
(SWITCHES, CLOSING; POWER CONDITIONING)  
(LASS; Systems)  
PICOSECOND OPTOELECTRONIC SWITCHING AND GATING IN SILICON  
D.H. Auston  
Bell Labs, Murray Hill, NJ 07974  
Applied Physics Letters, Vol. 26, No. 5, pp 101-103 (02/1975).  
Quasimetallic photoconductivity produced by the absorption of picosecond optical pulses in silicon transmission line structures has been used to devise electronic switches and gates which can be turned on and off in a few picoseconds. Electrical signals as large as 100 V can be switched by a few microjoules of optical energy. The switching speed was measured by correlating the response of two transmission gates in tandem, each having an aperture time of 15 psec. 5 Refs.  
Primary Keywords: Photoconductivity; Double Pulse; 0.53 Micron Light; 1.06 Micron Light; Surface Ionization; Volume Ionization; Start Switch; Crossover Switch  
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8099  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
PROGRESSIVE LIGHTNING. IV-THE DISCHARGE MECHANISM  
B.F.J. Schriener  
University Of The Witwatersrand  
Royal Society Of London Proceedings, Vol. A164, No. A916-7, pp 132-150 (01/1978).  
The authors present a model of the lightning process based on extensive experimental observation. The paper begins with a short review of the general discharge process. The leader process is then described in detail followed by a description of the mechanisms involved in the main stroke. Multiple strokes are also considered. 22 Refs.  
Primary Keywords: Lightning; General Survey; Modeling; Leader; Pilot Streamer; Stepped Leader; Current; Luminosity; Main Stroke  
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8100  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
THE POSSIBILITY OF PHOTODETACHMENT IN THE IMPULSE BREAKDOWN OF POSITIVE POINT-PLANE GAPS IN AIR  
F.D.A. Boylett and B.G. Williams  
Central Electricity Research Labs, Leatherhead, Surrey, UK  
British Journal Of Applied Physics, Vol. 18, pp 593-595 (05/1967).  
The relative importance of the roles of photodetachment and photoionization in the propagation of positive point-plane impulse corona in air is discussed. Consideration of the magnitudes of the cross sections for the two mechanisms as a function of photon energy reveals a higher efficiency for the photodetachment process. Further support for the conclusion that photodetachment is more probable than photoionization, in the circumstances considered, is drawn from experimental evidence such as the visual form of the corona and its dependence upon meteorological conditions. 5 Refs.  
Primary Keywords: Point-plane Gap; Air Gap; Photoionization; Photodetachment; Corona Propagation; Cross Section; Theory  
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8103  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Current)  
WIDE FREQUENCY RANGE CURRENT TRANSFORMERS  
J.M. Anderson  
General Electric Co, Schenectady, NY 12301  
The Review Of Scientific Instruments, Vol. 42, No. 7, pp 915-926 (07/1971).  
Current transformers with resistive loads are examined experimentally to determine some of the limitations to high frequency response. Coil resonances are avoided by placement of damping resistors around the secondary winding. This permits a relatively large number of secondary turns (50 or 100), improving low frequency response and increasing the i x t product, even for the highest frequency transformers. Uniform response to several gigahertz is obtained in a transformer with 6.4 mm window, while a range approximately 1 Hz to approximately 300 MHz is found in a larger transformer (12.7 cm dia and 2.5 cm window). Both ferrite and iron alloy cores are utilized. 8 Refs.  
Primary Keywords: Current Transformer; Wide Bandwidth; Resistive Load; Damping Resistor; Frequency Response Measurement  
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8104  
(ENERGY STORAGE, MECHANICAL)  
(Rotating Machines)  
TESTS ON THE CANBERRA HOMOPOLAR GENERATOR ARRANGED TO SUPPLY THE 5 MEGAWATT MAGNET  
E.K. Inell  
Australian National University, Canberra, Australia  
Journal Of Physics D: Applied Physics, Pp 1-9 (08/1975).  
The design and testing of the Canberra Homopolar Generator are discussed. The temporal histories of the temperatures of several components are presented for high (1 MA) and low (25 kA) current discharges. The dependence of performance on brush pressure is studied. 2 Refs.  
Primary Keywords: Homopolar Generator; Brush Temperature Study; Brush Pressure Study; High Current Discharge; Low Current Discharge  
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8105  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES)  
(Cos, Electrical; Surface Flashover)  
CONFIGURATIONS AND MODES OF AN H-PRESSED DISCHARGE  
L.D. Gorshkova, A.I. Pavlovskii, I.V. Podmoshenskii and V.A. Savchenko  
High Temperature, Vol. 9, No. 4, pp 762-764 (08/1971).  
Trans. From: Topofizika Vysokikh Temperatur 9, 844-846 (July-August 1971).  
The H-pressed discharge is a process in which a gas discharge is pressed against a dielectric by a magnetic field. The authors analyze the case, coaxial, and annular H-pressed discharge. Instabilities are discussed, as are the effects of wall vaporization. The radiation of the H-pressed discharge is found to agree well with that of an absolute black body. 5 Refs.  
Primary Keywords: Gas Discharge; H-pressed Discharge; Magnetic Field; Dielectric Trough; Stability Considerations  
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8106  
(BREAKDOWN STUDIES)  
(Gas, Optical)  
RESONANCE EFFECTS IN MULTIPHOTON IONIZATION OF ATOMS  
G. Mainfray and C. Manus  
CEA Centre d'Etudes Nucleaires, Saclay, France 92260  
Applied Optics, Vol. 19, No. 23, pp 3934-3940 (12/1980).  
The resonance effects in multiphoton ionization over a moderate laser intensity as observed in experiments is compared, with a close agreement found, to the effects predicted by theory. The observed resonance effects in a high intensity range cannot be as easily understood, and the authors give a qualitative explanation using the characteristic ionization time in the vicinity of the resonance. 23 Refs.  
Primary Keywords: Multiphoton Effect; Experiment; Theory; Good Agreement; Polarization Effects  
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8108  
(PARTICLE BEAMS, ELECTRON)  
(Target Interactions)  
HIGH-POWER ELECTRON BEAM PREIONIZED CO/SUB 2/ CW LASER MODELLING I: DESCRIPTION OF THE INVESTIGATED DEVICE AND NUMERICAL CALCULATIONS ON E-BEAM IONIZATION  
S. Martellucci, J. Quartieri, G. Mastroianni and S. Solimano  
Universita degli Studi-Napoli, Napoli, Italy  
Nuovo Cimento, Vol. 54, No. 1, pp 99-117 (11/1979).  
Part I of the paper devoted to modelling high-power CW lasers gives a brief description of the investigated device and uses an analytical approximation to Bethe's formula to calculate the following quantities: the space profiles in the discharge chamber of the electron beam energy, the stopping power, and the source term under operating conditions for four-component mixtures of practical interest. The energy loss of the primary beam in travelling through a thin Al foil is calculated. Parts II and III will be published promptly. Part II will be devoted to the plasma characteristics in the discharge chamber and to the kinetic and fluid-dynamic model of the laser. Part III will be devoted to an assessment of the numerical results obtained from the model and their comparison with experimental data. 20 Refs.  
Primary Keywords: Energy Deposition; Gas Dynamics; Modeling; Analytical Solution  
Secondary Keywords: Gas Laser Pumping  
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8109  
(BREAKDOWN STUDIES)  
(Lightning)  
SIMULATION OF LIGHTNING CURRENTS IN RELATION TO MEASURED PARAMETERS OF  
NATURAL LIGHTNING

J. Philpott  
Culham Lab, Abingdon, Oxfordshire, UK  
1975 Conference On Lightning And Static Electricity, pp 1-13 (04/1975).  
The authors begin this paper with a short discourse on the characteristics of natural lightning. Intracloud discharge and both positive and negative ground discharges are discussed with emphasis on stroke duration and peak current. The effects of these lightning strokes on aircraft are then discussed with a proposed new airworthiness requirement included. Lastly, requirements for effective lightning simulation are discussed. 30 Refs.  
Primary Keywords: Lightning Characteristics; Intracloud Discharge; Ground Discharge; Effects On Aircraft; Airworthiness Specification; Simulation  
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8110  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
FORMATION OF A POSITIVE BURST PULSE CORONA IN AIR, NITROGEN AND OXYGEN  
T. Takura  
Shizuoka University, Hamamatsu, Japan  
Journal Of The Physical Society Of Japan, Vol. 17, No. 9, pp 1434-1439 (09/1972).

The author utilizes Loeb's condition to derive an analytical solution for the onset of positive pulse burst corona in a point-point gap. Avalanche and photo-ionization are included to derive a formula to predict the onset of burst pulse corona and to estimate the effective absorption coefficient for the radiation produced. 16 Refs.  
Primary Keywords: Loeb's Condition; Point-point Electrodes; Ionizing Photons; Absorption Coefficient; Experiment; Theory

8111  
(BREAKDOWN STUDIES; SWITCHES, OPENING)  
(Exploding Wires; Explosive Fuses)  
THE EXPLODING WIRE PHENOMENON

C.A. Privette  
Jet Propulsion Lab, Pasadena, CA  
JPL Technical Report No. 33-113 (01/1963).  
Availability: N63-19235

NTIS  
A brief outline of the exploding wire phenomenon together with a description of some techniques employed in measuring various parameters of the explosion process is presented. Two copper wires, 1 and 3 mils in diameter, were exploded, utilizing a 16,000-J capacitor bank. These explosions are used as models for various theoretical descriptions concerning temperature and current histories. Results of these theoretical treatments predict maximum temperatures of approximately 100,000 amp. 12 Refs.  
Primary Keywords: Experiment; Theory; Simulation; Numerical Calculation; Copper Wire; Measurement Technique

8112  
(BREAKDOWN STUDIES; SWITCHES, OPENING)  
(Exploding Wires; Explosive Fuses)  
THEORETICAL ANALYSIS OF THE HYDRODYNAMIC FLOW IN EXPLODING WIRE PHENOMENA

C.A. Rouse  
Lawrence Livermore Lab, Livermore, CA 94550  
UCRL Report No. UCRL-5519-T (03/1959).  
Availability: UCRL-5519-T

NTIS  
Theoretical calculations of exploding wire phenomena have been carried out with an IBM 704 Lagrangian code. The model for this analysis assumes instantaneous energy deposition in the wire. Calculations were made with different conditions. Among those presented are (1) different attractive equations of state for the copper wire and (2) different equations of state for the surrounding air. The equations of state for the air are (a) a constant gamma-law gas and (b) the variable gamma-law gas calculated by F.R. Gilmore. The shock wave propagation in each is shown to require significantly different energies. The results are compared to calculations made without copper wire (energy assumed deposited in a volume of air equal to that of the wire) and with an analytic similarity solution for cylindrical shock waves. The propagation of the shock wave in air calculated with the Gilmore equation of state for air shows excellent agreement with that observed by F.D. Bennett. The second shock wave in the copper shows qualitative agreement with that observed by Bennett, but indicates that in the range of EMP, copper does not act like a constant gamma-law gas. As for similarity, it is shown that hydrodynamic flow during the explosion of wires is not similar. 7 Refs.

Primary Keywords: Exploding Wire; Copper Wire; Numerical Calculation; Shock Wave; Double Shock

8113  
(INSULATION, MATERIAL; PULSE GENERATORS)  
(Liquid Systems)  
DIELECTRICS STUDY FINAL REPORT

G.K. Simcox  
Energy Sciences Inc., Burlington, MA 01803  
DNA Report No. DNA2823F (06/1972).  
Availability: AD 743170

NTIS  
This reports the findings of an experimental study to investigate the dielectric strength of deionized water when pulse stressed by a 'double resonance' transformer. The data provide evidence that the prestress conditions do not significantly affect the results. Additionally, it is suggested that the relationship for maximum stress as a function of time and electrode area can be applied for stress times of 5-10 microseconds. The transformer generator is discussed in some detail. The conclusion is drawn that this generator form would be a sensible choice in a pulse system using pressurized water dielectric. High dielectric strengths are now claimed for this treatment with effective stress times of tens of microseconds, a range which is compatible with the transformer pulse signature. 2 Refs.

Primary Keywords: Dielectric; Deionized Water; 'Double Resonance' Transformer; Prestress; Waveshape Dependence

8114  
(PARTICLE BEAMS, ELECTRON; PARTICLE BEAMS, ELECTRON)  
(Target Interactions; Generation)  
PRODUCTION OF DENSE THERMONUCLEAR PLASMAS BY INTENSE RELATIVISTIC ELECTRON BEAMS

F. Winterberg  
University of Nevada System, Las Vegas, NV 89109  
Proceedings Of The International School Of Physics 'Enrico Fermi' Course: XLVIII (07/1969).  
The author discusses various aspects of thermonuclear fusion. The necessary characteristics of the target and the relativistic electron beam which it is to be bombarded with are discussed. Generation of the electron beam and its interaction with the target are also examined. Conversion of the nuclear reaction into useful power, and the application of the process as a rocket propulsion system are considered. A method for producing an intense ion beam is briefly presented. 17 Refs.

Primary Keywords: Target Interaction; Collective Effects; Superconducting Ring Generator

Secondary Keywords: E-beam Fusion  
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8115  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
100-KHZ QUENCHING SPARKGAPS HAVE 1E12 A/S CURRENT RISE

M.E. Austin  
General Electric Co, Valley Forge, PA  
Laser Focus, Vol. 11, No. 6, pp 79-80 (06/1975).  
A sparkgap using perforated quenching electrodes is presented. The sparkgap will allow a rise of 1E12 A/sec with repetition rates up to 100 kHz at an energy of 0.22 joules per pulse. A schematic of a high repetition rate pulseforming network using the sparkgap is given. 1 Refs.  
Primary Keywords: Quenching Spark Gap; Quenching Screen; Fast Current Rise; Rep-rated; High Frequency; Low Energy Per Pulse  
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8116  
(PULSE GENERATORS)  
(Trigger)  
A MAGNETIC-THYRISTOR GENERATOR PRODUCING HIGH-VOLTAGE NANOSECOND PULSES  
A.N. Vorobiev, V.M. Bogdanov, F.L. Gorchikov, V.G. Guk and A.A. Ushakov  
Leningrad Polytechnical Institute, Leningrad, USSR  
Instruments And Experimental Techniques, Vol. 17, No. 1, pp 110-111 (02/1974).  
Trans. From: Priroda i Tekhnika Eksperimenta 1, 103-104 (January-February 1974).

A compact generator which produces powerful nanosecond pulses is described. The length of the pulses across the load of 200 to 300 ohm is 9 to 12 nsec for a duration of the leading edge equal to 4 to 5 nsec. The repetition frequency of the pulses is up to 1.0 kHz; the power in the pulse is <25 kW; the amplitude of the pulse is <2.5 kV. The generator weight is 120 g. 2 Refs.  
Primary Keywords: Pulse Generator; Rep-rated; 2.5 kV Output; 1 kHz Repetition Rate; Light Weight; Thyristor; Ferrite Peaking Line  
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8117  
(SWITCHES, CLOSING; SWITCHES, CLOSING)  
(Systems; LASER)  
A LIGHT-CONTROLLED, HIGH-POWER PULSE SHAPER  
V.G. Glotov and G.G. Koblishvili  
Soviet Journal Of Optical Technology, Vol. 39, No. 9, pp 578-579 (09/1972).

The authors present a design for a system which shapes pulses that can then turn on a high power thyristor. The system has a high noise immunity, and the frequencies it can handle depend primarily on the time constant of the photodetector. 0 Refs.  
Primary Keywords: Radiation Detector; Pulse Amplifier; Thyristor Trigger  
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8118  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
ARC MOTIONS DRIVEN BY MAGNETIC FIELD IN SULFUR HEXAFLUORIDE (SF<sub>6</sub>/SUB 6/  
1. Susaki (1) and M. Omachi (2)  
(1) Toshiba Research and Development Center, Ukishima-cho, Kawasaki-ku, Kawasaki  
(2) Toshiba High Power Lab, Ukishima-cho, Kawasaki-ku, Kawasaki  
J. Jpn. Soc. Applied Physics, Vol. 14, No. 4, pp 487-493 (04/1975).

A magnetic field set up transverse to the field line was used to drive arcs in sulfur hexafluoride and in air. The arc motions were photographed using a high speed camera, and the arc speed was found to be faster in air than in sulfur hexafluoride. The arc moved relatively smoothly when copper electrodes were used, but arc spots could not be driven in the first stage when brass electrodes in sulfur hexafluoride were used. 10 Refs.  
Primary Keywords: Magnetic Field Driven Arc Motion; Various Gases; Lightning Arresters; Copper Electrode; Brass Electrode  
COPYRIGHT: 1975 PUBLICATION BOARD, JAPANESE JOURNAL OF APPLIED PHYSICS

8119  
(POWER CONDITIONING)  
(Pulse Transformers)  
EFFECT OF COPE CHARACTERISTICS ON PULSE-SHAPE DISTORTION BY A PULSE TRANSFORMER

S.C. Mdivin  
Radioelectronics And Communications Systems, Vol. 22, No. 3, pp 96-97 (01/1979).  
Trans. From: Izvestiya VUZ, Radioelektronika 22, 87-88 (1979).  
Expressions are derived which relate the shape of the core to the pulse-shape distortion. The effect of the shape of the cross section of the core on the core volume, the rise time of the pulse, and the voltage drop of the transformed pulse is discussed. 1 Refs.  
Primary Keywords: Core Characteristics; Minimum Volume; Short Rise Time; Design Considerations  
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8120  
(POWER CONDITIONING: POWER CONDITIONING)  
(Pulse Transformers; Linear Inductors)  
FERRITES FOR LINEAR APPLICATIONS II-PERFORMANCE REQUIREMENTS  
E.C. Snelling  
Mullard Research Labs.  
IEEE Spectrum, Vol. 9, No. 2, pp 26-32 (02/1972).  
The final installment of this article focuses on the applications and performance requirements of soft ferrite materials. Basic devices employing ferrites include inductors for FDM filters, wide-band and pulse transformers, and high-frequency power transformers. In the typical modern television receiver a total of about 0.6 Kg of ferrite cores is used in a variety of applications, such as line output transformers, deflection yokes, and convergence systems. 14 Refs.  
Primary Keywords: Soft Ferrite; Pulse Transformer; Inductor; Design Considerations; Losses  
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8122  
(ENERGY STORAGE, INDUCTIVE)  
(Systems)  
A PROPOSAL FOR THE CONSTRUCTION AND OPERATION OF AN INDUCTIVE STORE FOR 20 MEGAJOULES  
E.K. Inall  
Culham Lab, Oxfordshire, Oxfordshire, UK  
Journal Of Physics E: Scientific Instruments, Vol. 5, pp 679-685 (07/1972).

A proposal for coupling 20 MJ of energy initially stored in the Canberra homopolar generator, to a load in about 1.0 ms is described. The energy is first transferred to a coaxial inductor at a peak current and voltage of 1.5 MA and 190 V respectively. The opening of a fast mechanical switch which is being developed transfers the energy from the inductor to the load, producing a voltage of 1000 V across the latter. The system is intended for use with high energy lasers. 10 Refs.  
Primary Keywords: Homopolar Generator; Coaxial Inductor; Mechanical Switch; Low Voltage; High Current  
Secondary Keywords: Flash Lamp Driver  
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8123  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
KILOVOLTMEETER MEASURES AC AND DC WITH OVER 1E16-OHM INPUT RESISTANCE  
R.J. Gardner  
University of Alberta, Edmonton, Alberta, Canada  
Electronic Design, Vol. 27, No. 20, pp 90 (09/1979).  
The circuit measures high AC or DC voltages under true no-load conditions. Capacitors are used instead of the conventional resistive divider which eliminates loading problems and simplifies different al measurement. 0 Refs.  
Primary Keywords: Capacitive Voltage Divider; High Input Impedance; High Stability; DC Measurement Capability  
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8124  
(SWITCHES, CLOSING; BREAKDOWN STUDIES)  
(Gas Gaps, Optical; Gas, Optical)  
NANOSECOND TRIGGERING OF AIR GAPS WITH INTENSE ULTRAVIOLET LIGHT  
T.F. Godlove  
Naval Research Lab, Washington, DC 20375  
Journal Of Applied Physics, Vol. 52, No. 5, pp 1589-1596 (08/1981).  
Measurements are presented of the breakdown time of a conventional two-electrode air gap. The applied voltage is maintained below the sparking threshold and breakdown is caused by the emission of a 6-nanosecond burst of photoelectrons from the cathode, which produces space-charge distortion of the electric field. An auxiliary trigger spark provides the necessary light and results in cathode emission up to approximately 10 mA/cm. The dominant wavelength region is found to be approximately 1100 Å because of the relatively low air absorption and high photoelectric yield in this region. For a fixed gap spacing and using the highest light intensity available, the time delay is typically found to decrease from approximately 57/sub √ to a minimum delay 1/sub √ as the main gap voltage is increased from approximately 8X below threshold up to threshold. The minimum delay ranges from 10-60 nanosecond for the gap spacings studied and agrees with calculated values of gap spacing/electron drift velocity. The techniques developed have direct application to the triggering of conventional spark-gap switches and to pulsed light sources and may provide an additional tool for investigating some of the basic parameters of gaseous electronics. 15 Refs.  
Primary Keywords: Cathode Effects; Photoemission; Space Charge; Analysis; Overvoltage  
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8125  
(DIAGNOSTICS AND INSTRUMENTATION: DIAGNOSTICS AND INSTRUMENTATION)  
(Current; Voltage)  
OPTICAL METHOD FOR MEASUREMENT OF VOLTAGE AND CURRENT ON POWER SYSTEMS  
A.J. Rogers  
Central Electricity Research Labs, Leatherhead, Surrey, UK  
Optics And Laser Technology, Vol. 9, No. 6, pp 273-283 (12/1977).  
Methods of optically measuring voltage and current in high voltage systems are examined. The magneto-optic effect, the electro-optic effect, the piezo-optical effect, and the electrogyration effect are discussed. Free and enclosed path systems are considered along with the necessary detection and noise reduction techniques. 12 Refs.  
Primary Keywords: Basic Principles; Electro-optic Effect; Magneto-optic Effect; Electrogyration Effect; Noise Reduction  
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8126  
(PARTICLE BEAMS, ION)  
(Generation)  
SERV II: DESIGN REQUIREMENTS FOR INTEGRATING ELECTRIC PROPULSION INTO A SPACECRAFT  
R.J. Rulis  
Lewis Research Center, Cleveland, OH  
Journal Of Spacecraft And Rockets, Vol. 8, No. 3, pp 209-213 (03/1971).  
Design requirements for SERV II (Space Electric Rocket Test), and the way they were implemented are presented. Discussions are presented the thermal design considerations, electrical requirements, high-voltage handling methods, and thruster-power conditioner system requirements. Methods for testing the system just before launch are considered. 7 Refs.  
Primary Keywords: Ion Thruster; Performance Test; Power Transmission  
Secondary Keywords: Thermal Design; Mechanical Design  
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8127  
(POWER CONDITIONING)  
(Transient Suppressors)  
SIX WAYS TO CONTROL TRANSIENTS: VARISTOR, GAS-DISCHARGE AND RC SUPPRESSORS PROTECT CIRCUITS FROM DESTRUCTIVE SURGES  
R.W. Fax  
General Electric Co, Syracuse, NY 13201  
Electronic Design, Vol. 11, pp 52-57 (05/1974).  
Six different types of suppressors are given as possible devices for protecting circuits from high-voltage transients. Zener diodes, selenium devices, metal-oxide devices, silicon-carbide devices, gas-discharge (spark gap) devices, and resistor-capacitor networks are discussed. The devices are compared using their peak idle current, maximum current, peak power, effective clamping ratio, voltage range, and cost. 0 Refs.  
Primary Keywords: Zener Diode; Selenium Rectifier; Metal-oxide Device; Silicon-carbide Device; Spark Gap; RC Network; Design Considerations  
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8128  
(PARTICLE BEAMS, ION)  
(Generation)  
COMPUTATIONAL STUDY OF MAGNETIC DAM EFFECTS IN A HIGH IMPELANCE DIODE  
R.J. Barker, S.A. Goldstein and A.T. Drobot  
Naval Research Lab, Washington, DC 20375  
NRL Report No. 642 (10/1981).  
Availability: AD A136154  
NTIS  
Computer simulations have been conducted to test the 'magnetic dam' concept as a means for boosting the overall ion efficiency of high impedance diodes. The 'dam' consists of a cell located immediately behind the anode foil containing a wire along its central axis which carries a current flowing in a direction opposite to that in the diode gap. The azimuthal magnetic field generated by the wire current, 1/sub √, reflects the electrons crossing the foil back into the A-K gap at higher radii where their space charge can enhance ion emission over relatively large areas. Significant increases in the ion current were observed for several values of 1/sub √ but a simultaneous increase in electron current prevented gains in overall ion efficiency. Instead, only decreased impedances were observed. The cause of this phenomenon is explained and solutions which could benefit a wide range of future diode designs are presented. 7 Refs.  
Primary Keywords: 'Magnetic Dam' Diode; Numerical Calculation; Intense Ion Beam Generation; Magnetic Field Electron Reflection

8129  
(ELECTROMAGNETIC COMPATIBILITY)  
(Grounding And Shielding)  
CONSTRUCTION AND EVALUATION OF A PROTOTYPE ELECTROMAGNETICALLY SHIELDED ROOM  
M.A. Lanitter  
Naval Civil Engineering Lab, Port Hueneme, CA  
Technical Report No. R-454 (05/1986).  
Availability: AD 636179  
NTIS

An electromagnetically shielded room composed of 20-gage sheet-metal wall material with continuously soldered seams was constructed and evaluated at the Naval Civil Engineering Laboratory. The 20 x 20 x 8-foot room is a prototype model designed as a basis for determining specifications for the construction of large shielded room installations. Electromagnetic shielding evaluation of the room was performed in accordance with MIL STD-285, along with additional measurements at 1.0, 2.5, and 9.0 GHz. The lowest value of shielding effectiveness was 65 decibels at 14 kHz. Construction techniques for such design features as sheet-metal joints, soldered seams, power-line filtering, ventilation ducts, and cable raceways are discussed. Techniques for providing penetrations into the room for gas, water, and sewage were investigated. Measurements of the effect of small controlled openings into the room were determined. The acoustic shielding properties of the room are also given in this report. 7 Refs.  
Primary Keywords: Screen Room; Shielding Evaluation; Penetration Techniques; Line Filtering; Reliability

8130  
(BREAKDOWN STUDIES)  
(Gas, Electric)  
GAS BREAKDOWN CALCULATION: A COMPARATIVE STUDY  
T.A. Kior  
AFIL, Wright-Patterson AFB, OH  
GEF Report No. GEP/PM/76-7 (12/1976).  
Availability: AD A34434  
NTIS

An attempt is made to develop a simple yet accurate gas breakdown model which can be easily coupled to the hydrodynamic equations governing fluid flow in laser-target interactions. The accuracy of three relatively simple models is investigated. Each is compared with the more accurate and complex quantum kinetic model, to determine the conditions under which it maintains reasonable accuracy. A gas consisting of single monatomic species is assumed and attention is restricted to the early portion of the electron cascade. A temperature model is found to agree reasonably well with the quantum kinetic model at values of incident laser flux greater than 5E9 W/cm. A diffusion model is found to yield similar results. A two-temperature model, which is derived in an attempt to extend the range of the temperature model to lower values of incident flux, is found to be invalid. 15 Refs.  
Primary Keywords: Optical Breakdown; Air Breakdown; Threshold; Breakdown Modeling; Temperature Model; Two Temperature Model

8131  
(ELECTROMAGNETIC COMPATIBILITY)  
(Grounding And Shielding)  
GUIDE FOR SHIELDED ENCLOSURE CONSTRUCTION PROBLEMS  
Authors Unknown  
Naval Civil Engineering Lab, Port Hueneme, CA  
N Report No. N-877 (03/1967).  
Availability: AD 831828  
NTIS

This report touches on the important aspects of shielded room design. Shielding materials, door seals, and seams are discussed with recommendations given. Penetration of the shielding and power line filtering are shown to be important considerations needing attention from the outset. Long term reliability is addressed with typical problem areas identified and repair procedures presented. Test procedures are included. 8 Refs.  
Primary Keywords: Shielded Room; Soldered Joints; Door Seals; Shielding Penetration; Line Filtering; Test Procedure

8132  
(BRIEF COMMUNICATIONS)  
(Surface Phenomena)  
INVESTIGATING THE LUMINESCENCE ORIGINATING DURING THE ELECTRIC  
FULMINATION OF THIN WIRES  
M.P. Vanyukov and V.I. Isayenko  
Report No. FTD-77-771 (06/1962).  
Trans. From: Zhurnal Tekhnicheskoy Fiziki 32, 197-201 (1962)  
Availability: AD 286190  
NTIS

With the aid of an electron-optical scanner was investigated the development of luminescence and cloud of fulmination products originating during the fulmination of wires. Established were certain laws governing the rate of expansion of the luminous channel and cloud of fulmination products, as well as the localization of the zone of luminescence. 10 Refs.

8134  
(BREAKDOWN STUDIES)  
(Surface Phenomena)  
THE RELATION BETWEEN THE CHARGE TRANSPORTED AND NUMBER OF PHOTONS  
EMITTED IN PARTIAL DISCHARGES ON DIELECTRIC SURFACES  
J.S. Brzosko, J. Grudziński, A. Korczewski, E. Zukowski, M. Wojewódzka, M. Zukowski and J. Kunicki  
Białystok Div., Warsaw University, Białystok, Poland  
Journal Of Physics D: Applied Physics, Vol. 10, pp 1155-1158 (05/1977).

Experiments are described in which two-dimensional measurements were taken of the relationship between charge transported and photons emitted during creep discharges. This relation was found to be linear. NG2, with k differing for positive and negative corona. The difference is thought to be due to the different average energy of the electrons in the discharge channel. 10 Refs.

Primary Keywords: Partial Discharge; Charge Transport; Light Emission; Creep Discharge  
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8135  
(POWER CONDITIONING)  
(Pulse Transformers)  
MEGAMPERE PULSE TRANSFORMER FOR COAXIAL LOAD  
W.H. Clark and J.E. Myrberg  
Utah Research and Development Co., Inc., Salt Lake City, Utah 84104  
The Review Of Scientific Instruments, Vol. 37, No. 7, pp 883-885 (07/1966).

A transformer is described which delivers 2 MA into a low impedance load through a coaxial output line of about 6.35 mm inner conductor diameter and 12.7 mm cavity diameter. The transformer primary is connected to a 20 microfarad, 50 kV capacitor bank by forty-eight flexible coaxial cables. The ringing frequency of the system with the secondary shorted is 70 kc. 0 Refs.

Primary Keywords: Step Down Transformer; Pulse Transformer; 2 MA Current  
Secondary Keywords: Plasma Gun  
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8136  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
ELECTRIC BEHAVIOR OF SOME FLUOROGASES AND THEIR MIXTURES WITH NITROGEN  
G. Camilli, T.W. Liao and R.E. Plump  
General Electric Co., Pittsfield, MA 01201  
Electrical Engineering, Vol. 74, No. 7, pp 580-584 (07/1955).

The authors present data on several fluorogases and fluorogase-nitrogen mixtures in this paper. The breakdown voltage and corona threshold voltage for the gases and mixture are tabulated for AC, DC, and impulse voltages as a function of gas pressure and electrode spacing. Both uniform and nonuniform fields are considered using parallel-plate and rod-plane gaps. Correlations are made between gas molecular weight and breakdown voltage. Comparisons with air and sulfurhexafluoride are shown. 15 Refs.

Primary Keywords: Fluorocarbon; Dielectric Strength; AC Voltage; DC Voltage; Impulse Voltage; Corona Test; Comparison With Sulfurhexafluoride  
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8137  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
EXPANSION OF INITIAL HIGH-CURRENT SPARK CHANNELS  
C.C. Gallagher and M. Fischer  
AFRL, Bedford, MA 01730  
Applied Optics, Vol. 4, No. 4, pp 1151-1154 (09/1965).

The paper describes experiments in which a Javal Kerr cell, with exposure times of 2-8 nsec, is used to observe the expansion in air of spark channels. The sparks are triggered by a 50 nsec, 7 kv pulse resulting in a time jitter of less than a nanosecond. A current rise of 2012 A/sec is observed along with a maximum expansion velocity of 1.666 cm/sec. 2.6 nsec into the breakdown. 9 Refs.

Primary Keywords: Spark Channel Expansion; Several Gases; Erosion; Cloud; Light Emission Measurement  
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8138  
(BREAKDOWN STUDIES)  
(Solid, Optical)  
LASER-INDUCED ELECTRON EMISSION FROM SOLIDS: MANY-PHOTON PHOTOELECTRIC EFFECTS AND THERMIONIC EMISSION  
E.M. Logothetis and P.L. Hartman  
Cornell University, Ithaca, NY 14850  
Physical Review, Vol. 187, No. 2, pp 460-474 (11/1969).

The intensity dependence and energy distribution of laser-induced electron emissions were measured. The results are analyzed in terms of multiphoton ionization and thermionic emission. The materials used were Au, stainless steel, CsI, KCl, and Fe. Two-photon photoelectric spectroscopy was performed in CsI and KCl, and the spectrum obtained is discussed. 36 Refs.

Primary Keywords: Photoelectric Emission; Laser Induced Breakdown; Multi-photon Effects; Experiments; Theory  
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8139  
(PULSE GENERATORS; DIAGNOSTICS AND INSTRUMENTATION)  
(Line Type, Voltage)  
PRODUCTION AND MEASUREMENT OF ULTRA-HIGH SPEED IMPULSES  
R.C. Fletcher  
Massachusetts Institute of Technology, Cambridge, MA  
The Review Of Scientific Instruments, Vol. 20, No. 12, pp 861-869 (12/1949).

The capabilities and limitations of several impulse generators and voltage dividers, and a micro-oscilloscope sweep circuit for dealing with kilovolt impulses in the millimicrosecond range, are described. The most successful combination produces and measures an impulse of a rise time equal to 1E-10 sec. 4 Refs.

Primary Keywords: Transmission Line; Pulse Generator; Three Gap Spark Gap; Voltage Divider; 20 kV Voltage; Subnanosecond Rise Time  
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8140  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
STEP RESPONSE OF MEASURING SYSTEMS FOR HIGH IMPULSE VOLTAGES  
F.C. Creed (1), G. New (1) and T. Kawamura (2)

(1) National Research Council, Ottawa, Ontario, Canada  
(2) University of Tokyo, Institute Of Industrial Science, Tokyo, Japan  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-86, No. 11, pp 1428-1432 (11/1967).

The generalized impulse voltage measuring system is analyzed as a complete entity using the step response approach. The analysis shows that the response time of the system is not determined correctly by conventional methods and a new method is presented. Revisions to the conventional methods are proposed which will enable the true response time of the system to be determined. Five separate measuring systems are investigated experimentally using both techniques and the predicted and measured values of the conventionally measured response time are shown to be in very good agreement. As a result of the investigation, certain specific suggestions are made for revisions to existing standards for this type of measurement. 6 Refs.

Primary Keywords: Calibration; Probe Characterization; Step Response; Predicted Response; Good Agreement  
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8141  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
A HIGH-IMPEDANCE, NANOSECOND RISE TIME PROBE FOR MEASURING HIGH-VOLTAGE IMPULSES  
G. New  
National Research Council, Ottawa, Ontario, Canada  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-87, No. 9, pp 1780-1786 (09/1968).

Normal voltage dividers for high-voltage impulses are connected to the test object by an open air line which, when considered as part of the measuring system, gives an initially low input impedance to that measuring system due to the characteristic impedance of the line. This initially low impedance has been overcome by building a divider which can be used as an attenuator probe connected directly to the point on the test object at which the voltage is to be measured. By having the probe at a distance from the ground plane, the input capacitance can be kept low, thus allowing the probe to have a shorter rise time. Examples of results are given. 6 Refs.

Primary Keywords: Resistive Voltage Divider; Direct Connection To Test Point; Small Input Capacitance; Analysis  
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8143  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Current)  
A CURRENT TRANSFORMER FOR LOW LEVEL MICROSECOND PULSES  
W.J. Sarjeant and E. Beaman  
University of Western Ontario, London, Ontario, Canada  
The Review Of Scientific Instruments, Vol. 41, No. 5, pp 775-776 (05/1970).

This note describes the design and operating characteristics of a large area (15 and 45 mm) current transformers. The small section unit was constructed with a Philips K-300-500 toroidal core. A single turn of enameled wire was first wound around the periphery of the toroid and held in place by a wrapping of 3 mm wide masking tape. The toroid main winding was then close wound on by hand with a 20 turn of enameled wire. The center aperture of the toroid, continuously partially around the core, for external magnetic fields, the main winding looks like a single turn. By connecting the single turn first wound around the periphery of the toroid in series with the main winding, effectively no net flux due to external fields is coupled to the circuit. 1 Refs.

Primary Keywords: Current Transformer; Fast Rise; Sub-ampere Current  
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8144  
(DIAGNOSTICS AND INSTRUMENTATION)  
(B-field)  
A SUBNANOSECOND RISE TIME FLUXMETER  
D.G. Pellinen  
Physic International Co., San Leandro, CA 94577  
The Review Of Scientific Instruments, Vol. 42, No. 5, pp 667-678 (05/1971).

A self-integrating search coil with a rise time of approximately 0.4 nsec has been developed for measuring kilogauss magnetic fields in adverse environments. A coaxial calibration fixture with a field rise time of 0.35 nsec was built to calibrate the fluxmeters. 10 Refs.

Primary Keywords: Fluxmeter; Kilogauss Fields; Half-nanosecond Rise Time; Self Integrating  
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8146  
(ENERGY STORAGE, INDUCTIVE)  
(Systems)  
ADVANCED CONCEPTS FOR PHOTON SOURCES VOLUME 2: FAST SWITCHING OF VACUUM  
MAGNETIC ENERGY STORES  
V. Bailey, L. Demeter, J. Sanford, A. Noeth and D. Sloan  
Physic International Co., San Leandro, CA 94577  
DNA Report No. DNA 3680F-2 (10/1973).  
Availability: AD A015386  
NTIS

Inductive (magnetic) energy storage systems are analyzed in terms of their application to generation of ultra-high power pulses. Such systems can transform low-power energy inputs into high-power outputs (power multiplication) by shortening the energy delivery time. Energy transfer from magnetic store to resistive load can approach 100 percent efficiency. Models of several accelerated metallic plasma transfer switch geometries indicate that such switches can be energetically efficient and can produce substantial voltage multiplications. Using a versatile and extensively diagnosed apparatus, experiments were conducted to test these predictions. The experiments confirmed the modeling and established design criteria for metallic wire plasma switches. Operating at 25 kV energy level, a coaxial switch produced narrow (60 to 300 nsec) voltage spikes with voltage and power multiplications of 3 - 8 Refs.  
Primary Keywords: Magnetic Energy Stores; Fast Switching; Power Multiplication; Power Pulse Compression; Vacuum Switch; Metallic Plasma Switch

8149  
(INSULATION, MATERIAL; BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Reviews; Gas, Electrical; Gas Gaps, Electrical)  
HIGH VOLTAGE INSULATION OF LINES AND EQUIPMENT  
M.K. Kalina  
FTD Report No. FTD-MC-23-749-71 (09/1971).  
Trans. From: Leningrad Polytechnic Institute. Transactions, 258, 3-9, 61-78, 88-105, 116-117, 132-137, 161-171 (1965)  
Availability: AD 734055  
NTIS

This report includes nine selected papers on insulation testing, pulse generators, and switching. The first article describes a 2.2 MV pulse generator. Due to space limitations, the authors chose a stacked Marx generator. The design philosophy and testing are presented. The next five papers concern the theory and operation of spark gaps. Low power simulation of high power operation, arc quenching, parallel operation, and jitter studies are included. The last three papers are devoted to insulation of high voltages. Breakdown of liquid and solid insulations are included. 56 Refs.  
Primary Keywords: Marx Generator; Ceramic Capacitor; High Power Switch; Simulation; Arc Extinction; SF<sub>6</sub> Gas; Dielectric Strength; Insulation Breakdown; Insulation Polarization

8151  
(PULSE GENERATORS)  
(Current)  
CURRENT PULSE GENERATOR  
G.L. Chakhlov  
Academy of Sciences of the USSR, Tomsk, USSR  
Instruments And Experimental Techniques, Vol. 21, No. 2, pp 398-400 (04/1978).  
Trans. From: Priroda i Tekhnika Eksperimenta 2, 123-125 (March-April 1978)  
A new scheme for a current pulse generator with a combined 'coil-capacitance' is discussed. The operation is analyzed in terms of an equivalent circuit. The efficiency of the generator is tested on a model made from sections of a pulsed capacitor of 40 microfarad and 800 V at a frequency of 400 Hz and a maximum current of 80 A. 3 Refs.  
Primary Keywords: 'Coil Capacitance'; Equivalent Circuit; Analysis; Model Test; Reprinted  
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8153  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
NANOSECOND PULSE BREAKDOWN IN GASES  
P. Felgenthal and J.M. Mead  
Space Sciences Inc., Walham, MA  
Physical Review, Vol. 139, No. 6A, pp A1796-A1804 (01/1965).  
A theory describing the formative period of breakdown in gases following the sudden application of a DC electric field has been developed and applied to the design of experiments to measure lag times in nine gases. It is shown analytically that under certain conditions pulsed-DC and pulsed-microwave breakdown are directly comparable. A pulsed-DC experimental system is described which permits measurements of the formative period over a wide range of applied field, gas pressure, and gas space. For those gases where sufficient basic data are available, theoretical and experimental results are in good agreement. 13 Refs.  
Primary Keywords: Gas Breakdown; Nine Gases; Formative Time Lag; Step Voltage Breakdown; Microwave Breakdown; Theory; Experiment; Comparison Of Results  
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8154  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
OBSERVATION OF A CORE IN AN EXPLODED LITHIUM WIRE PLASMA BY REFLECTION OF LASER LIGHT  
T.A. Leonard  
University of Michigan, Ann Arbor, MI  
Journal Of Applied Physics, Vol. 44, No. 3, pp 1380-1381 (03/1973).  
A thin lithium wire which was extended and exploded in vacuum was probed with a Q-switched ruby laser. Strong reflections of the ruby laser light were observed from a 'core' in the plasma when the pressure was greater than 1E-4 Torr. Changes in the plasma and discharge properties near this pressure suggested the possibility of a core of unevaporized wire due to current shunting through the surrounding air. The presence of this core was unexpected because of the relatively large discharge current and small wire diameter. When the pressure was below 5E-4 Torr a 'core' was never observed and there was no evidence of current shunting. 9 Refs.  
Primary Keywords: Exploding Wire; Lithium Wire; Vacuum Environment; Ruby Laser Diagnostic; High Density Plasma 'Core'  
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8155  
(PARTICLE BEAMS, ELECTRON; BREAKDOWN STUDIES)  
(Generation; Electrodes)  
ON THE THEORY OF FIELD EMISSION FROM METALS  
F.I. Itskovich  
Khar'kov Military Engineering College  
Soviet Physics JETP, Vol. 23, No. 5, pp 945-953 (11/1966).  
Trans. From: Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki 50, 1425-1437 (May 1966)  
Field emission from a metal single crystal is investigated for an arbitrary electron dispersion law. If the Fermi surface is intersected by an axis  $p_{\text{sub}} z'$  perpendicular to the emitting surface of the sample, the free electron theory formula for the field emission current remains valid except for the pre-exponential factor. Otherwise the conservation of the tangential quasimomentum of an electron emitted from the metal leads to the results that the work function  $\phi$  in the exponential must be replaced by a larger quantity  $\psi$ . The distance between the Fermi surface and the  $p_{\text{sub}} z'$  axis can be estimated from the difference  $\psi - \phi$ , which thus yields definite information concerning the electron spectrum of the metal. 5 Refs.  
Primary Keywords: Field Emission; Metal Crystal; Fermi Surface; Free Electron Theory; Electron Energy Spectrum  
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8157  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
PULSED HIGH-PRESSURE ARC IN HELIUM AND HYDROGEN  
Yu.R. Knyazev, E.S. Borovik, R.V. Mitin and V.I. Petrenko  
Soviet Physics Technical Physics, Vol. 12, No. 3, pp 374-380 (09/1967).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 37, 523-532 (March 1967)  
This paper gives the results of an investigation of a pulsed high-pressure arc in helium and hydrogen at pressures up to 4E5 atm/abs 27 and currents up to 40 kA. The pulsed arc is produced by the discharge of a capacitor bank through a long, DC, high-pressure arc, or through a thin wire. The results of electrical and spectral investigations and of measurements of the visible brightness of the steady and pulsed arcs are given. Photographs of steady and pulsed arcs obtained by means of a camera obscura are also shown. 5 Refs.  
Primary Keywords: Steady Arc; Pulsed Arc; High-pressure Arc; Capacitor Bank; DC Arc; Thin Wire  
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8160  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
SPARKING POTENTIALS OF SATURATED HYDROCARBON GASES  
J.S. Mirza, C.W. Smith and J.H. Calderwood  
University of Salford, Salford, UK  
Journal Of Physics D: Applied Physics, Vol. 4, No. 8, pp 1126-1133 (08/1971)  
The Paschen curves of sparking potential as a function of the pressure - gap length product (pd) are given for normal pentane, hexane, heptane, octane and decane. The measurements of sparking potential have been made from a pd of about 30 Torr cm through the minimum sparking potential, about 1 Torr cm, to approximately 3E-3 Torr cm. A previous empirical equation giving the sparking potential for values of pd greater than minimum sparking potential has been modified by the addition of two constants and an extra term, so that it now fits the Paschen curves for the whole of the extended range of the measurements while retaining the constants introduced by previous workers. Values of the constants are tabulated for the hydrocarbons listed above and a detailed comparison between the sparking potentials calculated from the equation and experimental results is given for n-octane. 9 Refs.  
Primary Keywords: Hydrocarbon Gas; Several Gases; Paschen Curve; Empirical Equation  
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8161  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
THE BEHAVIOR OF INPUT-POWER DENSITY IN EXPLODING-WIRE RESTRIKES  
A.C. Vlasov  
Royal Institute of Technology, Stockholm, Sweden  
Journal Of Applied Physics, Vol. 43, No. 4, pp 1985-1987 (04/1972).  
The input power per unit volume of the restrike channel of thin exploding wires reaches its maximum slightly before the electrical conductivity has reached its maximum. In its turn, the electrical conductivity reaches its maximum before the current and the total power input have reached their maxima but slightly after the inflex observed on the voltage oscillograms. The reason why the input power per unit volume and the electrical conductivity reach their maxima much earlier than the current and the total power input remains seems to be closely connected with the magnetohydrodynamics of the restrike channel, which have not yet been satisfactorily treated because of the complexity of the problem. 5 Refs.  
Primary Keywords: Exploding Wire; Current Pulse; Current Restrike; Input Power; Plasma Conductivity; Magnetohydrodynamics  
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8164  
(BREAKDOWN STUDIES)  
(Liquid, Electrical)  
THEORY OF BREAKDOWN OF THIN LIQUID DIELECTRIC LAYERS  
G.S. Kuchinskii  
Soviet Physics-Technical Physics, Vol. 11, No. 7, pp 964-969 (01/1967).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 36, 1297-1304 (July 1966)  
The breakdown of thin liquid dielectric layers (thickness of the order of 1E-3 cm) is of considerable significance in the treatment of partial discharges initiated in layers of insulating material (e.g., paper impregnated with a dielectric fluid). In this case the initial partial discharges are struck in layers of the impregnating compounds between layers of the solid insulator in the normal technological practice of drying and impregnation. This paper discusses the theory of breakdown in thin layers of liquid dielectric, using mineral oil as an example. 12 Refs.  
Primary Keywords: Liquid Breakdown; Thin Layer; Partial Discharge; Insulation Breakdown; Townsend Coefficient Measurement  
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8165  
(BREAKDOWN STUDIES)  
(Solid, Electrical)  
TIME LAGS IN THE ELECTRICAL BREAKDOWN OF GLASS IMMersed IN WATER  
M.N. Azam and H. Dickinson  
University College of Swansea, Singleton Park, Swansea, Wales  
British Journal of Applied Physics, Vol. 12, pp 419-420 (08/1961).  
When measuring the electric breakdown strength of cover glass immersed in deionized water, time lags to breakdown were observed. The mean statistical time lag was  $(12 \pm 1)$  microsec. The breakdown strength between spherical electrodes was found to be  $(11.4 \pm 1) \times 10^6$  V/cm. 8 Refs.  
Primary Keywords: Cover Glass Breakdown; Water Insulation; Sphere Electrodes; Delay Measurement  
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8166  
(PULSE GENERATORS; POWER CONDITIONING)  
(Capacitive; Nonlinear Resistors)  
TIME-DEPENDENT CRITICAL DAMPING OF A CAPACITOR-DISCHARGE CIRCUIT  
M. Pillier, P.C. Archibald and J.M. Johnson  
Naval Weapons Center, China Lake, CA 93555  
Journal of Applied Physics, Vol. 42, No. 12, pp 4899-4901 (11/1971).  
Optimal design of a heat-sensitive variable resistor in the circuit of a pulsed capacitor discharge provides a physically simple method of damping without the ringing currents which may shorten capacitor life. Computer simulation is utilized to determine the optimum design parameters and materials of the variable resistor. 3 Refs.  
Primary Keywords: Pulse Generator; Spark Gap; Ringing Circuit; Capacitor Damping; Nonlinear Damping Resistor  
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8167  
(BREAKDOWN STUDIES)  
(Liquid, Electrical)  
USE OF THE DIMENSIONAL AND SIMILARITY METHODS IN INVESTIGATING PULSE DISCHARGE IN WATER  
I.Z. Okun  
Soviet Physics-Technical Physics, Vol. 12, No. 9, pp 1267-1273 (03/1968).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 37, 1729-1738 (September 1967).  
The present article is concerned with the discharge of a storage capacitor across the discharge gap in water. By using the dimensional and similarity methods and some other considerations, we shall derive the relationships determining the amplitude of cylindrical compression waves in a liquid and the portion of the energy released in the channel that is transformed into the energy of the cylindrical compression wave. Similarity criteria which make it possible to simulate pulse discharge in the same liquid were obtained. The similarity relationships were checked experimentally. We also derived criteria which secured the similarity of only the electric characteristics of discharge. The discharge channel shape was stabilized (straightened) by means of a thin wire (Nichrome,  $d = 0.03$  mm). 6 Refs.  
Primary Keywords: Water Gap; Numerical Calculation; Simulation; Cylindrical Geometry; Compression Wave; Theory; Experiment; Discharge Stabilization  
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8169  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
VACUUM BREAKDOWN WITH NANOSECOND PULSES  
M.V. Belkin and E.A. Avilov  
Soviet Physics-Technical Physics, Vol. 15, No. 8, pp 1339-1340 (02/1971).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 40, 1723-1724 (August 1970).  
The time response of 1-2 mm long vacuum gaps to the application of 200 ns nanosecond pulses is studied. It is found that an increase of the pulse factor from 1.5 to 3.2 reduces the decay time of the voltage pulse across the gap from 55 to 5 nsec. 7 Refs.  
Primary Keywords: Vacuum Gap; Millimeter Gap; Hemispherical Gap; Disc-plane Gap; Voltage Fall  
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8170  
(PULSE GENERATORS; PULSE GENERATORS)  
(LC Systems)  
VOLTAGE-MULTIPLICATION OF STEEP PULSES  
G.A. Mesyats  
Tomsk Polytechnic Institute, Tomsk, USSR  
Instruments And Experimental Techniques, No. 6, pp 1097-1100 (12/1963).  
Trans. From: Pribury i Tekhnika Eksperimenta 6, 95-97 (November-December 1963).  
It is shown that if LC networks are connected in series through spark discharge gaps DG, and if the capacitance and inductance of each subelement are lower than those of the previous one by one order of magnitude, approximately, a voltage  $U_{sub} n / 2 / U_{sup} n / 2$  may be obtained across the capacitor C/sub n/.  $U_{sub} n / 2$  being the input voltage. The influence of the internal loop-resistances and of the capacitance-inductance ratio of adjacent loops upon the value of  $U_{sub} n / 2$  is calculated. The obtained expressions are verified by experiment. 5 Refs.  
Primary Keywords: LC Generator; Series Connection; Voltage Multiplication; 10 ns Rise Time; Design Considerations; Experimental Verification  
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8171  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
FAST ELECTRONS AND X-RAY RADIATION DURING THE INITIAL STAGE OF GROWTH OF A PULSED SPARK DISCHARGE IN AIR  
Yu.L. Stankevich and V.G. Kalinin  
Soviet Physics-Doklady, Vol. 12, No. 11, pp 1042-1043 (05/1968).  
Trans. From: Doklady Akademii Nauk SSSR 177, 72-73 (November, 1967).  
In order to explain the mechanism of formation of a spark discharge in gases at high pressure, it is necessary to consider the energy of avalanche electrons during the initial stage of the discharge. It has been shown that for voltages close to the static breakdown value the kinetic energy of electrons in isolated avalanches does not exceed several electron volts. However, when the avalanche grows into a streamer the field in the vicinity of the avalanche should increase by several times. When this occurs, an electron during each free path can acquire more energy than is required to compensate the losses during elastic collisions, excitation, and ionization. Under these circumstances the electron is continually accelerated and in some instances can acquire an energy comparable to the applied voltage. 3 Refs.  
Primary Keywords: Avalanche Breakdown; Streamer Formation; Bremsstrahlung Radiation; Electrode Material Effect  
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8172  
(REVIEWS AND CONFERENCES; ENERGY STORAGE, INDUCTIVE, CIRCUIT CALCULATIONS)  
(Reviews; Inductors; Inductance)  
INDUCTANCE CALCULATIONS: WORKING FORMULAS AND TABLES  
F.W. Grover  
Union College  
Publisher: General Publishing Company Ltd. (01/1946).  
This book is a treatise on inductance calculation and inductor design. The author begins with a short discussion of the basic theory of inductance and proceeds to present general and specific calculations for several coil designs. Geometry considerations, such as calculation of mean distances between wires of various cross sections and corrections for large cross section wires, are considered in some detail. Compact working formulas for several common coil configurations are presented along with examples of their use. The effect of high frequencies on coil performance is discussed. 119 Refs.  
Primary Keywords: Inductance Calculations; Basic Theory; Working Formulas; General Coil Configurations; Geometry Considerations; High Frequency Corrections  
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8173  
(REVIEWS AND CONFERENCES)  
(Reviews)  
AN INTRODUCTION TO HIGH-VOLTAGE EXPERIMENTAL TECHNIQUE  
D. Kind  
Technische Universität Braunschweig, Braunschweig, FRG  
Publisher: Friedr. Vieweg & Sohn Verlagsgesellschaft mbH, Braunschweig (01/1978).  
The fundamentals of high voltage technique should be studied not only by someone entering the field of high voltage engineering, but should be reviewed periodically by everyone that utilizes high voltages. This book provides an introduction to the basics of high voltage AC, DC, and impulse voltage generation and measurement; non-destructive testing; safety; and laboratory organization consistent with the principles discussed. The book includes several safe and simple experiments to familiarize novices with high voltage technique. Rigorous mathematics are not included so that the student need not have an advanced education to benefit from the information included. 126 Refs.  
Primary Keywords: Review; AC Voltage; DC Voltage; Impulse Voltage; Generation; Measurement; Safety; Laboratory Layout; Voltage Engineering  
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8174  
(REVIEWS AND CONFERENCES; BREAKDOWN STUDIES)  
(Reviews; Reviews)  
ELECTRICAL BREAKDOWN OF GASES  
J.M. Meek Ed. and J.D. Craggs Ed.  
University of Liverpool, Liverpool, UK  
Publisher: John Wiley & Sons (01/1978).  
Electrical breakdown is a very complex phenomenon that is very difficult to treat comprehensively. This book does just that, however. Edited by J.M. Meek and J.D. Craggs, the book includes eleven chapters on fundamentals of breakdown, vacuum breakdown, spark breakdown in uniform and nonuniform fields, corona, effect of ionizing and laser initiated breakdown, RF breakdown, time delay and voltage fall, and electrode effects. Each chapter is written by an expert in the field and is both complete and accurate. Each chapter also contains many useful references for a more detailed treatment. 1950 Refs.  
Primary Keywords: Electrical Breakdown; Fundamental Process; Vacuum Breakdown; Spark Breakdown; Safety; Uniform Field; Nonuniform Field; Corona; Voltage Fall; Time Lag; Radiation; Laser Initiated Breakdown; RF Breakdown; Channel Characteristics  
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8175  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
PULSED ARC IN ARGON AT PRESSURES UP TO 108 N/M<sup>2</sup> SUP 2/ (1000 ATM)  
S.S. Borevsk, V.P. Kantsidel, Yu.R. Knyazev, R.V. Mitin and V.I. Petrenko  
Soviet Physics-Technical Physics, Vol. 12, No. 4, pp 502-506 (10/1967).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 37, 703-709 (April 1967).  
This paper describes an apparatus which can be used to investigate pulsed arcs in argon at pressures up to 108 N/m<sup>2</sup> sup 2/; currents up to 50 kA, and pulse lengths of approximately 1E-3 sec. The high pressure is obtained by the evaporation of liquefied argon in a closed space. The parameters of the plasma formed in the discharge are: charged particle density up to approximately 4E19 cm<sup>3</sup> sup -3/, temperature approximately 1E4 Deg.K, and degree of ionization almost unity. Radiation absorption processes are shown to play a significant role in such a plasma. 7 Refs.  
Primary Keywords: Pulsed Arc; Very High Pressure; Argon Gas; Very High Plasma Density; Low Temperature; High Ionization  
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8176  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
CATHODE EMISSION MECHANISM IN AN ARC DISCHARGE  
V. I. Rakhovskii  
All-Union Institute, Moscow, USSR  
Soviet Physics-Technical Physics, Vol. 10, No. 12, pp 1707-1709  
(06/1966).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 35, 2228-2231 (December 1965)  
The theory of the vapor cathode was first proposed by Slepian about forty years ago. The idea of using a vapor cathode was subsequently proposed by Rothstein, who suggested an entirely new concept of the possibility of metal-type conduction in the cathode vapor cloud due to a high concentration of neutral particles in that region. A reappraisal of Rothstein's ideas in the light of new developments is the object of this article. At the present time the emission processes in cathodes made from materials with high vapor pressure and low melting and boiling points (Mo, Ag, Cu) are attributed to field emission. It is assumed that the electron emission occurs at the metal surface in an extremely large (approximately  $1E7 - 1E8$  V/cm) electric field; this field is generated by the ion space charge at the surface which causes the field emission. 14 Refs.  
Primary Keywords: Vacuum Breakdown; Vapor Virtual Cathode; Ion Impact; Cathode Heating; Hot Spots; Field Emission  
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8177  
(SWITCHES, CLOSING; SWITCHES, CLOSING)  
(Gas Gaps, Materials; Liquid Gaps, Materials)  
DESTRUCTION OF ELECTRODES BY ELECTRIC DISCHARGES OF HIGH CURRENT DENSITY  
V. E. Il'in and S. V. Lebedev  
P. M. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow, USSR  
Soviet Physics-Technical Physics, Vol. 7, No. 8, pp 717-721 (02/1963).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 32, 986-992 (August 1962)  
A possible mechanism for the erosion of electrons is considered on the basis of an assumption as to the decisive role of Joule heat. It is shown that, for a current density on the electrode surface  $j < 1E6$  A/cm<sup>2</sup>, the Joule model correctly describes the qualitative aspects of the fundamental characteristics of the erosion. 29 Refs.  
Primary Keywords: Electrode Erosion; Anode Erosion; Cathode Erosion; Electrode Heating Model; Air Gap; Kerosene Gap  
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8178  
(BREAKDOWN STUDIES)  
(Electrodes)  
DETERMINATION OF THE ELECTRIC FIELD ENHANCEMENT FACTOR AND CRATER DIMENSIONS IN ALUMINUM FROM SCANNING ELECTRON MICROGRAPHS  
R. Nackem  
University of Sheffield, Sheffield, UK  
Journal Of Applied Physics, Vol. 45, No. 1, pp 114-118 (01/1974).  
An electron stereoscopic microscope is used to examine the surfaces of an aluminum cathode and an aluminum anode which have been subjected to repeated sparkings under an ultrahigh vacuum ( $1E-9$  Torr), at voltages of up to 45 kV. The cathode surface is observed to contain large numbers of protrusions which give rise to an enhanced local electric field at the tip of the protrusions. The field enhancement factor,  $\beta$ , at the microprojections is determined from the scanning electron micrographs. The values of  $\beta$  are in reasonable agreement with those obtained from the Fowler-Nordheim theory when applied to the current-voltage measurements in the region prior to breakdown. The anode surface is completely devoid of protrusions and contains large numbers of craters. The diameters and depths of typical craters are also determined. 61 Refs.  
Primary Keywords: Vacuum Breakdown; Aluminum Electrodes; Cathode Microprojections; Anode Craters; Field Enhancement Factor; Fowler-Nordheim Theory  
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8179  
(BREAKDOWN STUDIES)  
(Electrodes)  
EFFECT OF ELECTRODE ROUGHNESS ON BREAKDOWN VOLTAGE  
V. A. Avrutskii  
Moscow Power Engineering Institute, Moscow, USSR  
Soviet Physics-Technical Physics, Vol. 18, No. 3, pp 389-393 (09/1973).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 37, 1911-1920 (October 1967)  
Experimental data are given on the electrical strength and statistical scatter in the breakdown voltages for gaps with electrodes with rough surfaces for air pressures of 1-5 atm (absolute). The surface state is checked before each series of strength measurements. The experimental results are compared with theory using expressions that allow for the effect of irregularities of the cathode surface on the electrical strength of the gap. Expressions are derived for the breakdown probability distribution as a function of voltage; these are in good agreement with the experimental statistical characteristics. 7 Refs.  
Primary Keywords: Cathode Microprojections; Field Enhancement; Several Discharges; Breakdown Voltage Scatter; Experiment; Comparison With Theory  
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8180  
(BREAKDOWN STUDIES)  
(Electrodes)  
EFFECT OF ELECTRODE ROUGHNESS ON THE ELECTRICAL STRENGTH OF COMPRESSED GASES  
V. A. Avrutskii, G. M. Goncharenko and E. N. Prokhorov  
Moscow Power Engineering Institute, Moscow, USSR  
Soviet Physics-Technical Physics, Vol. 18, No. 3, pp 386-388 (09/1973).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 43, 615-619 (March 1973)  
Using the Townsend mechanism, the effect of impact ionization processes on the electrical strength of compressed gases is studied in the strong field of electrode surface microirregularities. A self-maintained discharge condition is derived for the case in which the microprojections of the surface are shaped like a prolate spheroid of revolution. Good agreement between the calculations and the known experimental data is obtained for air, nitrogen, and hydrogen if the height of the microprojections used in the calculations is  $1E-1 - 1E-4$  cm. 14 Refs.  
Primary Keywords: Cathode Microprojections; Field Enhancement; Theory; Prolate Spheroid Of Revolution; Numerical Calculation; Comparison With Experiment  
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8181  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
ELECTRICAL BREAKDOWN IN CSF/SUB 8/  
R. Geballe and F. S. Linn  
University of Washington, Seattle, WA  
Journal Of Applied Physics, Vol. 21, No. 1, pp 592-594 (01/1958).  
The breakdown potential of a new gas, CSF/sub 8/, has been measured over the range from a  $\Delta$  delta = 4 to 200 mm x cm under conditions approximating plane parallel geometry. A comparison of breakdown in air Freon 12 and CSF/sub 8/ in the same apparatus indicates the ratio of the strengths of these gases to be approximately 1:2.3, respectively. CSF/sub 8/ decomposes rapidly during breakdown into CF/sub 4/ and SF/sub 4/ with a consequent doubling of pressure and appreciable increase in breakdown potential. 12 Refs.  
Primary Keywords: CSF/sub 8/ Gas Breakdown; Parallel-plane Electrodes; Freon; Air; Comparison; Decomposition Products  
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8182  
(SWITCHES, CLOSING; ELECTROMAGNETIC LAUNCHERS)  
(Vacuum Gaps, Materials; Railguns, Materials)  
ELECTRODE EROSION IN SPARK DISCHARGES  
D. J. Vargo and F. L. Taylor  
Lewis Research Center, Cleveland, OH  
Journal Of Applied Physics, Vol. 33, No. 9, pp 2911-2912 (09/1962).  
Performance of rail-type plasma accelerators may be strongly affected if electrode erosion processes add mass to the moving plasma. The dependence of the erosion rate on the characteristics of the discharge has not been clearly defined in previously published data. Therefore, in the study of a zero length plasma accelerator, an attempt was made to determine the electrode erosion characteristics of capacitor discharge systems in high vacua (3 to  $5E-6$  mm Hg). 5 Refs.  
Primary Keywords: Plasma Accelerator; Rail Gun; Electrode Erosion; Vacuum Discharge; Dependence On Waveform  
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8183  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
EXPERIMENTAL STUDY OF ELECTRICAL EXPLOSION  
B. P. Pereaud and K. B. Abramova  
Soviet Physics-Doklady, Vol. 9, No. 8, pp 665-668 (02/1965).  
Trans. From: Doklady Akademii Nauk SSSR 157, 837-840 (August 1964)  
The first paper devoted to a study of electrical explosion of fine metal wires and foils dates from the year 1774. Although a number of papers have been published on the question, electrical explosion has still not been investigated to a sufficient extent. A study has been made of electrical explosion of copper wires at the A. F. Ioffe Physicotechnical Institute, AN SSSR. Most attention was given in this work to the energy side of the matter and to the accompanying radiation process. The most important results of this study are given in the present paper. 6 Refs.  
Primary Keywords: Exploding Wire; Threshold; Wire Voltage; Wire Current; Photograph; Diagnostic; Comparison With Black Body Radiation  
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8184  
(SWITCHES, OPENING)  
(Explosive Fuses)  
EXPLODING FOIL DEVICES FOR SHAPING MEGAMP CURRENT PULSES  
R. Bealing and P. G. Carpenter  
Atomic Weapons Research Establishment, Aldermaston, Berkshire, UK  
Journal Of Physics E: Scientific Instruments, Vol. 3, pp 689-692 (05/1972).  
High speed condenser banks provide pulsed magnetic fields for impulsive loading experiments. The capability of the methods can be extended by using exploding foils to shape the current that forms the magnetic field. Two circuit applications, the crowbar switch and dynamic damping resistance, are detailed and their use in pulse shaping is illustrated. The necessary principles of exploding foils are discussed, and results comparing calculated and measured 'action integrals' for a range of common foil materials are given. The multichannel crowbar switch described is novel in that it requires no ancillary circuitry and is timed automatically by the primary bank discharge. An exploding foil ruptures insulant mechanically in many sites, giving a low inductance closure 0.3 microsec after the foil explodes. 2 Refs.  
Primary Keywords: Exploding Foil; Pulse Shaping; Capacitor Discharge; Nonlinear Resistor; Low Inductance  
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8185  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
INVESTIGATION OF A CYLINDRICAL, AXIALLY BLOWN, HIGH-PRESSURE ARC  
W. Hermann, U. Kogelschatz, K. Regaller and E. Schade  
Brown, Boveri & Co Ltd, Baden, Switzerland  
Journal Of Physics D: Applied Physics, Vol. 7, No. 4, pp 607-619 (03/1974).  
An experimental arrangement for the production of a quasi-stationary, high-current arc is described. It is stabilized by an axial gas flow in a high-pressure environment (current: 1900 A, pressure: 23 atm, gas: nitrogen). The conditions are described under which part of the arc assumes a cylindrical form. For such an arc the radial temperature distribution was measured. Because of the cylindrical shape a relatively simple evaluation yields quantitative data about the local radiative energy balance and the other energy transport mechanisms. This leads, for the first time, to a quantitative understanding of the different physical processes in this arc, and makes it possible to formulate a simplified arc model which is useful in practical applications. 24 Refs.  
Primary Keywords: High-current Arc; Nitrogen Arc; Axially Flowing Gas; 23 atm Pressure; Radial Temperature Distribution  
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**8203**  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
**THEORETICAL PROPERTIES OF SPHEROIDALLY-SYMMETRIC STATIC ARCS**  
A.K. Milder and D. Whittaker  
University of Liverpool, Liverpool, UK  
British Journal Of Applied Physics, Vol. 18, pp 427-441 (04/1967).  
A steady-state spheroidally-symmetric discharge with losses solely by conduction is analysed theoretically and its main properties summarized in dimensionless form in a nomogram. Included as special cases are the unbounded arc, the cylindrical arc and the filled-tube model. Radial variations are described by Legendre functions of complex degree. 5 Refs.  
Primary Keywords: Steady-state Arc; Conduction Losses; Nomogram; Unbounded Arc; Cylindrical Arc; Thermal Equilibrium  
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**8205**  
(REVIEWS AND CONFERENCES; POWER TRANSMISSION)  
(Reviews; Transmission Lines)  
**TRANSMISSION LINES WITH PULSE EXCITATION**  
H.G. Booker, Ed. and N. DeClaris, Ed.  
Publisher: Academic Press, Inc. (London) Ltd. (01/1969).  
The transmission of electrical signals is essential for research in pulsed power. Transmission lines under pulsed and sinusoidal excitation are considered in this book. The general equations are derived for general transmission lines including losses and then are shown to simplify to the lossless approximation. Laplace transforms are introduced and several simple line geometries are solved as examples. The Bergeron diagram is demonstrated by example and lumped and nonlinear problems are shown to be solvable by this method. Sinusoidal solutions are given for several geometries using plane notation. Pulse distortion by losses is discussed in detail with a brief discussion of dispersion included. 8 Refs.  
Primary Keywords: Transmission Line; Basic Equations; Losses; Laplace Transform Solution; Graphical Solution; Pulse Distortion; Reflections  
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**8215**  
(BREAKDOWN STUDIES; SWITCHES; CLOSING)  
(Gas, Optical; Gas Gaps, Optical)  
**ELECTRON DENSITIES IN LASER-TRIGGERED HYDROGEN SPARKS**  
S.K. Dhal, P.F. Williams, R.J. Crumley and M.A. Gundersen  
Texas Tech University, Lubbock, TX 79409  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 3, pp 164-167 (09/1980).  
We have used Stark broadening measurements of the  $H_{\alpha}$  Beta emission line to determine the temporally and spatially resolved electron density in laser-triggered hydrogen sparks. In this paper the results of this work are presented and compared with earlier work on conventional overvoltage sparks. 14 Refs.  
Primary Keywords: Laser-triggered Breakdown;  $H_{\alpha}$  Beta; Laser; Uniform Field Breakdown; Hydrogen Gas; Electron Density Profile; Stark Broadening  
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**8225**  
(PULSE GENERATORS)  
(Capacitive)  
**A PULSE CIRCUIT FOR EXCITATION OF A PARTICLE ACCELERATOR ELECTROMAGNET**  
E.I. Lukonin, V.D. Semenov and E.G. Fumen  
Academy of Sciences of the USSR, Tomsk, USSR  
Instruments And Experimental Techniques, Vol. 17, No. 6, pp 1563-1564 (12/1974).  
Trans. From: Pribury i Tekhnika Eksperimenta 6, 17-19 (November-December 1974).  
A new method of betatron electromagnet excitation is considered using current pulses of quasitriangular form. The energy storing capacitor operates in a unipolar mode with respect to voltage and the pulse repetition frequency is regulated. 5 Refs.  
Primary Keywords: Pulse Generator; Triangular Output; Partial Capacitor Discharge; Thyristor Switch  
Secondary Keywords: Betatron Magnet  
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**8229**  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
**ATMOSPHERIC EFFECTS ON THE DIELECTRIC STRENGTH OF A VACUUM GAP WITH PROCESSED ELECTRODES**  
M.V. Tatarinova and N.E. Novikov  
Engineering Physics Institute, Moscow, USSR  
Soviet Physics-Technical Physics, Vol. 22, No. 7, pp 985-986 (07/1977).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 47, 1568-1569 (July 1977).  
High dielectric strengths in vacuum systems are achieved and maintained for considerable lengths of time. With molybdenum electrodes 1.7 cm in diameter, a vacuum gap of 1 mm can withstand a voltage 55-60 kV without a single breakdown for 50 h. The current in these experiments does not exceed 10<sup>-8</sup> A. At higher voltages and at the same current level, the time delay before the first breakdown is shorter, 2 h at 70 kV and 20 min at 90-110 kV. The high dielectric strength is achieved by means of a glow discharge, through the removal of contaminants, through the removal of the surface layer damage during the mechanical treatment, and through the formation of a surface microrelief by the discharge. Both electrodes are treated in an oil-free vacuum and in a pure inert gas. In this paper we report a study of the dielectric strengths of a vacuum system after electrodes processed in the manner described above are exposed to the atmosphere. The dielectric strength of the vacuum system is compared for gaps of d1 mm and d2 0.5 mm. 3 Refs.  
Primary Keywords: Vacuum Breakdown; Electrode Conditioning; Exposure To Atmosphere; Change Of Breakdown Characteristic  
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**8230**  
(PARTICLE BEAMS; ELECTRON)  
(Generation)  
**BEAM GENERATION IN FOIL-LESS DIODES**  
J. Chen and R.V. Lovelace  
Cornell University, Ithaca, NY 14850  
The Physics Of Fluids, Vol. 21, No. 9, pp 1623-1633 (09/1978).  
A study is made of the generation of intense relativistic electron beams in rectangular and cylindrical foilless diodes. The diode space charge is treated self-consistently. The electron emission from the cathode is assumed to be space-charge-limited. A strong axial magnetic field is assumed to prevent the electrons from reaching the anode surface(s) directly, and to constrain the electron motion to be approximately one-dimensional. A useful dimensionless measure of the diode potential  $\phi_{\text{sub}}/c^2$  is epsilon, where epsilon is proportional to  $\phi_{\text{sub}}/c^2$ , the electron rest mass and charge, and the speed of light. Properties of the diodes are first analyzed in the ultra-relativistic limit,  $\epsilon \rightarrow 0$ , where the condition for space-charge-limited emission gives rise to a linear singular integral equation. This equation is solved for rectangular diode geometry, and the solutions are studied in detail. In particular, the diode impedance is independent of  $\phi_{\text{sub}}/c^2$ , and the beams are, in general, hollow. The beam particle kinetic energy flux,  $\Gamma_{\text{beam}}/\text{sub } p$ , decreases as the beam width,  $b$ , increases; for  $b \rightarrow 0$ ,  $\Gamma_{\text{beam}}/\text{sub } p \rightarrow 0$  where  $a$  is the diode width. A treatment of the diodes is then given for small but nonzero values of epsilon. For finite epsilon, there is a nonrelativistic Child-Langmuir sheath of thickness approximately  $\epsilon^{1/2}$  at the cathode surface. 12 Refs.  
Primary Keywords: Field Emission Diode; Foilless Diode; Theory; Space-charge-limited Emission; Axial Magnetic Field; Numerical Calculation; 1-d Calculation  
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**8231**  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES)  
(Gas, Electrical; Electrodes)  
**CONDITIONS FOR INITIATION OF A DISCHARGE IN A SPHERICAL GAS GAP WITH A PLASMA CATHODE**  
Yu.E. Kraindel and N.Ya. Levine  
Academy of Sciences of the USSR, Tomsk, USSR  
Soviet Physics Journal, Vol. 17, No. 3, pp 183-186 (03/1974).  
Trans. From: Izvestiya Vysokikh Uchebnykh Zavedenii, Fizika 17, 113-117 (March 1974).  
The flow of current in a gas gap between a concave plasma cathode and a positive electrode is considered. A simplified theoretical model is used to obtain the conditions for electrical breakdown and the equations for prebreakdown values of the current and the gap width. 8 Refs.  
Primary Keywords: Gas Breakdown; Plasma Cathode; Plane Anode; Space-charge Layer; Prebreakdown Current; Variable Gap Spacing; Experiment; Theory  
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**8233**  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
**DETERMINATION OF TEMPERATURE AND OTHER PARAMETERS OF AN EXPLODING-WIRE PLASMA BY MEANS OF SELF-REVERSAL OF LINES AND ABSORPTION SPECTRA**  
G.G. Il'in, E.M. Nurmatov and I.S. Fishman  
Kazan State University, Kazan, USSR  
High Temperature, Vol. 13, No. 2, pp 266-271 (04/1975).  
Trans. From: Teplofizika Vysokikh Temperatur 13, 268-294 (March-April 1975).  
Measurements are made on the plasma formed by an exploding copper wire of 0.15 mm diameter by means of time-resolved emission and absorption spectra. The radial distribution of the atomic density and the temperature are obtained using various copper emission lines. The temperature is found by the method of Bartels. 11 Refs.  
Primary Keywords: Exploding Wire; Copper Wire; Plasma Diagnostics; Plasma Temperature  
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**8236**  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
**DISSOCIATION OF SF<sub>6</sub>/SUB 6/, CF<sub>4</sub>/SUB 4/, AND SiF<sub>4</sub>/SUB 4/ BY ELECTRON IMPACT**  
V.H. Dibeler and F.L. Monier  
Journal Of Research, Vol. 40, pp 25-29 (01/1948).  
The dissociation by electron impact of SF<sub>6</sub>/SUB 6/, CF<sub>4</sub>/SUB 4/, and SiF<sub>4</sub>/SUB 4/ has been studied with a consolidated mass spectrometer. Data are also given on the appearance potentials of various ions in the mass spectra and measurements on the isotope abundance of sulfur, carbon, and silicon. The observed appearance potentials of the F<sup>+</sup>/SUB 19+ ion in SF<sub>6</sub>/SUB 6/ and CF<sub>4</sub>/SUB 4/ and the C<sup>+</sup>/SUB 12+ ion in CF<sub>4</sub>/SUB 4/ were found to be lower than the calculated value assuming formation of a positive atom ion and a free electron, but nearly equal to the calculated value assuming the formation of a positive atom ion and a negative fluorine ion. The large relative abundance of the SF<sub>6</sub>/SUB 6/ 4/sup ++/ ion and SF<sub>6</sub>/SUB 6/ 6/ and the CF<sub>4</sub>/SUB 4/ 2/sup ++/ ion in CF<sub>4</sub>/SUB 4/ is taken to indicate the formation of these ions by removal of two F<sup>+</sup>/SUB 19+ ions in the former and possibly an F<sup>+</sup>/SUB 19+ ion and a free electron in the latter case. 16 Refs.  
Primary Keywords: Molecular Dissociation; Electron Impact; Ion Formation Probability; Mass Spectrometer Diagnostic  
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**8237**  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
**EFFECT OF GAS PRESSURE ON ELECTRIC BREAKDOWN AND FIELD EMISSION**  
D. Albert, D. Lee, E.M. Lyman and M.E. Tomaschke  
University of Illinois, Urbana, IL  
Journal Of Applied Physics, Vol. 38, No. 2, pp 680-681 (02/1967).  
In a recent paper, we presented a physical picture for the initiation of electrical breakdown between metallic electrodes in an ultra-high vacuum. Based on the enhancement of the electric field at the cathode surface by the projections of the cathode, this picture related the initiation process to the properties of pre-discharge field-emission currents. One of the significant consequences of this work has been the development of a physical explanation for an effect which has often been noted but heretofore not understood. To explain this so-called gas effect, we assume as a starting point the breakdown model based on field emission from submicroscopic projections. When gas is introduced, the significant decrease in field emission is here attributed to the selective sputtering of the emitting whiskers by ions formed in the volume by electron bombardment of the gas molecules. 8 Refs.  
Primary Keywords: Gas Breakdown; Variation With Gas Pressure; Field Emission; Cathode Microprojections; Dependence On Microprojection Size  
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8238  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
ELECTRON EMISSION PRECEDING ELECTRICAL BREAKDOWN IN VACUUM  
R.P. Little and M.T. Whitney  
Naval Research Lab, Washington, DC 20375  
Journal Of Applied Physics, Vol. 34, No. 8, pp 2430-2432 (88/1963).  
An applied field of 1ES V/cm produced electron emission from apparently smooth surfaces at room temperature. It is found experimentally that this prebreakdown emission is independent of emitter temperature up to 1800 Deg.K. Using a shadow electron microscope, projections about 2 micron high capable of producing field enhancements on the order of 180 have been found on optically polished cathodes at prebreakdown emission sites. This, with other evidence, strongly indicates that prebreakdown emission is Fowler-Nordheim field emission, due to a geometrical field enhancement. 11 Refs.  
Primary Keywords: Vacuum Breakdown; Prebreakdown Current; Temperature Dependence; Microprojections; Fowler-Nordheim Equation  
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8239  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
EXACT RELATIVISTIC SOLUTION FOR THE ONE-DIMENSIONAL DIODE  
N.R. Jory (1) and A.M. Trivelpiece (2)  
(1) Varian Associates, Palo Alto, CA 94304  
(2) University of Maryland, College Park, MD 20742  
Journal Of Applied Physics, Vol. 40, No. 10, pp 3924-3926 (89/1969).  
Exact relativistic solutions for the one-dimensional space-charge limited diode, and for the one-dimensional diode with finite field at the cathode plane are given. The results are compared with approximate solutions which are useful in different energy ranges. 5 Refs.  
Primary Keywords: Space-charge-limited Diode; Electron Flow; Theory; 1-d Simulation; Relativistic Solution; Exact Solution  
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8240  
(PULSE GENERATORS; ENERGY STORAGE, CAPACITIVE)  
( Marx; Marx Generators)  
HIGH-VOLTAGE PULSE GENERATOR IN THE NANSECONDE RANGE  
V.M. Knyazev and V.A. Lyubimov  
Institute Of Theoretical And Experimental Physics, Moscow, USSR  
Instruments And Experimental Techniques, Vol. 1, pp 85-86 (82/1969).  
Trans. From: Pribery i Tekhnika Eksperimenta 1, 82-84 (January-February 1969)  
The article describes a 26-stage generator of high-voltage pulses (g.v.p.) intended as a supply for a streamer-type flash camera operating with a 8.5m gap. This g.v.p. produces pulses with a rise time of 16 nsec and a nominal amplitude of 1 MV. 4 Refs.  
Primary Keywords: Pulse Generator; 1 MV Output Voltage; Compact Size; 16 ns Rise Time; 8 ns Fall Time  
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8242  
(SWITCHES, CLOSING; BREAKDOWN STUDIES)  
(Gas Gaps, Materials; Electrodes)  
INVESTIGATION OF THE NEAR-ELECTRODE REGIONS OF AN ARC DISCHARGE BETWEEN ELECTRODES OF DIFFERENT CHEMICAL COMPOSITION  
I.F. Seliverstova, M.F. Tsypankov and N.K. Zaitsev  
Journal Of Applied Spectroscopy, Vol. 24, No. 2, pp 138-142 (82/1976).  
Trans. From: Zhurnal Prikladnoi Spektroskopii 24, 208-213 (February 1976)  
In arcs at atmospheric pressure, current transfer in the interelectrode gap is effected with the assistance of ionized atoms of the electrode material. Vaporization of the electrodes takes place by the action of 'hot spots' - high-temperature, local sources of heat. If the cathode and anode have identical chemical compositions, then the predominant entry of the material of one or other electrode into the discharge gap is determined by the polarity of the electrode, i.e., by the characteristics of the current transfer at the electrode-plasma boundary. Therefore, by using dissimilar electrodes, a change of the rate of vaporization of the cathode-electrode should lead to a change of the dynamics of the near-electrode region and, consequently, of the nature of striking of the electrode. This paper is devoted to a study of the dynamics of the near-electrode region, when materials with different properties are used as counterelectrodes. These investigations can be used, for example, when selecting a cycle of operation for difficult-to-replace electrodes (RHD generators) in facilities where the preferential vaporization of one of the electrodes is necessary (spot welding), etc. 9 Refs.  
Primary Keywords: Gas Breakdown; Electrode Effects; Hot Spots; Polarity Effects; Similar Electrode Materials; Dissimilar Electrode Materials  
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8243  
(PARTICLE BEAMS, ION)  
(Generation)  
METHOD OF GENERATING VERY INTENSE POSITIVE-ION BEAMS  
J.M. Creedon, I.D. Smith and D.S. Prone  
Physic International Co. San Leandro, CA 94577  
Physical Review Letters, Vol. 35, No. 2, pp 91-94 (87/1975).  
The combination of multiply reflected electrons and positive ion flow in a reflex triode arrangement is analyzed. Under certain conditions it is possible to generate very intense beams of positive ions with this device. The analysis demonstrates that the energy loss and scattering of the electrons as they pass through the anode have a major effect on the ion and electron currents. Solid fractional-range anodes are shown to produce more intense ion beams than semitransparent mesh anodes. 8 Refs.  
Primary Keywords: Reflex Triode; Analysis; Theory; Electron Reflection; Ion Flow; Foil Anode  
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8244  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
MULTIPLE-SPARK OPERATION OF A MEGAVOLT TRIGATRON  
A.S. El'channov, V.G. Emel'yanov, V.M. Koval'chuk, G.A. Mesyets and Yu.F. Potapitsyn  
Academy of Sciences of the USSR, Tomsk, USSR  
Instruments And Experimental Techniques, Vol. 17, No. 2, pp 416-418 (84/1974).  
Trans. From: Pribery i Tekhnika Eksperimenta 2, 103-105 (March-April 1974)  
A megavolt gas-filled trigatron having a spark ignition delay time  $t_{\text{sub}} d/\tau = 5.1 \text{ to } 0.5 \text{ nsec}$  and double the range of working voltages is described. A dielectric bushing that projects above the plane of the main electrode is used in the firing section of the trigatron. It is revealed that an optimal amplitude of the starting pulse exists for obtaining the minimal  $t_{\text{sub}} d/\tau$ . For parallel operation of two trigatrons the commutation time was reduced almost by a factor of 2 for a discharged current of 26 kA. 2 Refs.  
Primary Keywords: Trigatron; Multichannel Operation; Multiple Triggers; 1 MV Operating Voltage; Subnanosecond  
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8245  
(INSULATION, MAGNETIC)  
( )  
NEGATIVE ION LOSSES IN MAGNETICALLY INSULATED VACUUM GAPS  
J.P. Vandevender, R.W. Stinnett and R.J. Anderson  
Sandia Labs, Albuquerque, NM 87115  
Applied Physics Letters, Vol. 38, No. 4, pp 229-231 (82/1981).  
Negative ion losses have been observed in a long, self-magnetically insulated transmission line after the electrons are insulated. Time of flight spectra are consistent with  $H/\text{sub } 2/\text{sup } -$ ,  $O/\text{sub } 2/\text{sup } -$ ,  $C/\text{sub } 2/\text{sup } -$ , and heavier molecular ions with energies corresponding to the full anode-cathode potential difference. The negative ion current density  $J/\text{sub } 1/\text{sup}$  is a sensitive function of the conditions under which the cathode plasma is produced. 11 Refs.  
Primary Keywords: Magnetic Insulation; Ion Lasers; Cathode Plasma; Ion Backscattering  
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8246  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
PRODUCTION OF ANNULAR ELECTRON BEAMS BY FOILLESS DIODES  
R.B. Miller, K.R. Prestwich, J.M. Poukey and S.L. Shope  
Sandia Labs, Albuquerque, NM 87115  
Journal Of Applied Physics, Vol. 51, No. 7, pp 3586-3515 (87/1980).  
A number of important aspects of the production of annular electron beams by foilless diodes are examined, both theoretically and experimentally. The theories of Ott, Antonsen, and Lovelace (OAL) and Chen and Lovelace (CL) are compared, and the CL theory is extended to include the effect of an axial gap in an appropriate fashion. For the case of finite magnetic field strengths, Larmor orbits are examined and radial oscillations of the beam profile are predicted from a beam envelope analysis. Experimental results obtained with both low- and high-impedance sources have been compared with the theory, and based on such studies, the design and construction of an intense hollow beam generator are described. For the case of finite magnetic field strengths, Larmor orbits are examined and radial oscillations of the beam profile are predicted from a beam envelope analysis. Experimental results obtained with both low- and high-impedance sources have been compared with the theory, and based on such studies, the design and construction of an intense hollow beam generator are described. For the case of finite magnetic field strengths, Larmor orbits are examined and radial oscillations of the beam profile are predicted from a beam envelope analysis. Experimental results obtained with both low- and high-impedance sources have been compared with the theory, and based on such studies, the design and construction of an intense hollow beam generator are described. 18 Refs.  
Primary Keywords: Field Emission Diode; Foilless Diode; Annular Beam; Beam Oscillation; Comparison With Theory; 2 MeV Beam Energy  
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8247  
(PARTICLE BEAMS, ION)  
(Generation)  
PRODUCTION OF 0.5-TW PROTON PULSES WITH A SPHERICAL FOCUSING, MAGNETICALLY INSULATED DIODE  
D.J. Johnson, G.W. Kuska, A.V. Farnsworth Jr., J.F. Quintenz, R.J. Leeper, E.J.T. Burns and S. Humphries Jr.  
Sandia Labs, Albuquerque, NM 87115  
Physical Review Letters, Vol. 42, No. 9, pp 618-613 (82/1979).  
The production, focusing, and numerical simulation of a 0.5-TW proton beam is reported. This beam is produced with a spherical, magnetically insulated, ion diode fed symmetrically by the dual-pulse-line Proto I generator. The ions are accelerated with electric fields due to a virtual cathode supported by magnetic field surfaces. Approximately 75% of the diode electrical power is delivered to ions and 25% of the ion beam is focused upon thin, 1-cm-diam, 1-cm-long conical targets to produce the first experimental ion-driven implosions. 14 Refs.  
Primary Keywords: Proton Beam; Virtual Cathode; High Efficiency; Contoured Magnetic Field; Experiment; Theory; Numerical Calculation  
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8248  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
RELATIVISTIC PLANAR DIODE IN A MAGNETIC FIELD  
E.M. Weisman  
Systems Science and Software, La Jolla, CA 92038  
Applied Physics Letters, Vol. 39, No. 5, pp 447-449 (89/1981).  
The exact steady-state solution for the planar relativistic diode in space-charge-limited conditions is given in the presence of magnetic fluxes below magnetic insulation. It is shown that, as in the classical case, at fixed diode voltage the value of the current density reaching the anode goes discontinuously from a finite value to zero as a function of the magnetic flux at the magnetic insulation cut-off point. The limiting current density just below cutoff is given as a function of voltage and gap distance. This steady-state one-dimensional result below and very near the magnetic insulation threshold is in contradiction with experimental observations. 11 Refs.  
Primary Keywords: Planar Diode; Space-charge-limited Operation; Transverse Magnetic Field; Magnetic Insulation; Cutoff Field; Theory; Comparison With Experiment  
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8249

(REVIEWS AND CONFERENCES)  
(Reviews)

## MILLIMICROSECOND PULSE TECHNIQUES (SECOND EDITION)

I. A. D. Lewis (1) and F. M. Wells (2)  
(1) Royal Radar Establishment, Malvern, Worcestershire, UK  
(2) Atomic Energy Research Establishment, Harwell, Berkshire, UK  
Publisher: Pergamon Press (01/1959).

'Millimicrosecond Pulse Techniques,' though somewhat dated, contains a wealth of material concerning basic pulse generation and diagnostic techniques. The book contains chapters on lossless and lossy transmission line analysis, pulse generators, pulse transformers and transforming lines, pulse amplifiers, and cathode ray oscilloscopes. In addition, chapters on practical aspects of using pulsed power techniques in nuclear physics are included. Many practical applications are given. Detailed mathematical analyses are included. 711 Refs.

Primary Keywords: Transmission Line; Pulse Transformer; Pulse Generator; Pulse Amplifier; Pulse Diagnostics; Voltage Divider; Analysis; Application  
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8250

(PARTICLE BEAMS, ELECTRON)  
(Generation)

## THEORY OF FOIL-LESS DIODE GENERATION OF INTENSE RELATIVISTIC ELECTRON BEAMS

E. Ott, T. M. Antonsen Jr. and R. V. Lovelace  
Cornell University, Ithaca, NY 14850

The Physics Of Fluids, Vol. 20, No. 7, pp 1180-1184 (07/1977).

A study is made of the generation of intense hollow relativistic electron beams in a foilless diode. A strong magnetic field is assumed so that the electron motion is one dimensional. Also, the electron motion is considered to be ultra-relativistic. The problem of the self-consistent space charge in the diode is reduced to a singular integral equation. This integral equation is solved and the nature of the solutions is discussed. The beam density increases at the beam edges and has a minimum in the beam interior. The diode impedance as a function of the beam thickness and geometry is discussed. 19 Refs.

Primary Keywords: Field Emission Diode; Foilless Diode; Strong Axial Magnetic Field; 1-d Electron Flow; Space Charge; Theory

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8252

(PULSE GENERATORS; ENERGY STORAGE, CAPACITIVE)

## ARKAD'EV-MARK GENERATOR IN A CONDUCTING SHIELD

I. M. Roife, E. V. Seredenko and B. A. Stekol'nikov  
Scientific-Research Institute Of Electro-Physical Equipment, Leningrad, USSR

Instruments And Experimental Techniques, Vol. 14, No. 6, pp 1681-1683 (12/1971)

Trans. From: Priroda i Tekhnika Eksperimenta 6, 87-88 (November-December 1971)

Results are presented of an investigation of a pulse-voltage generator which is designed to operate in a tank filled with N/sub 2/ under pressure and differs from well-known pulse-voltage generator networks for the nanosecond range in that the high-voltage pulse shaping is achieved under conditions of a noticeable influence of the tank. 3 Refs.

Primary Keywords: Marx Generator; Pulse Shaping; Interaction With Container; Delay Measurement; Spark Gap

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8254

(BREAKDOWN STUDIES; SWITCHES, CLOSING)

## ELECTRODE GAS MATERIAL IN A HIGH-FREQUENCY CONDENSED SPARK DISCHARGE

G. G. Barvinko, A. M. Borbat and A. S. Dem'yanchuk  
Journal Of Applied Spectroscopy, Vol. 7, No. 2, pp 117-118 (12/1966).

Trans. From: Zhurnal Prikladnoi Spektroskopii 7, 163-165 (1967)  
Electrode consumption becomes of primary importance in the analysis of thin wires, finished components, etc. The degree of use of the material is also important. We have examined the consumption rate and degree of use of the material in a high-frequency condensed spark discharge. 1 Refs.

Primary Keywords: Electrode Erosion; AC Arc; Condensed Spark; High-Frequency Condensed Spark

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8256

(BREAKDOWN STUDIES)

## DYNAMICS OF ELECTRODE SPOTS IN AN ELECTRIC ARC

A. V. Brichkin, A. V. Bolotov and T. V. Borisova  
Soviet Physics-Technical Physics, Vol. 11, No. 7, pp 929-934 (01/1967).

Trans. From: Zhurnal Tekhnicheskoi Fiziki 36, 1251-1258 (July 1966)  
The mechanism of expansion and movement of the cathode and anode spots in a DC arc is considered in relation to the thermal state and emissive properties of the electrode. The experimental technique used to investigate a moving arc and the nature of the operation of copper electrodes is described. A plot of the current density in the electrode spots of arcs on copper electrodes against the electrode temperature is given. 11 Refs.

Primary Keywords: DC Breakdown; Cathode Spots; Temperature Measurement; Copper Electrodes; Spot Movement; Erosion

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8257

(BREAKDOWN STUDIES)

## EFFECT OF CORONA CHARGE ON THE FORMATION OF A LONG POSITIVE SPARK UNDER THE ACTION OF A VOLTAGE PULSE

E. M. Bazelyan

Soviet Physics-Technical Physics, Vol. 11, No. 2, pp 267-272 (08/1966).

Trans. From: Zhurnal Tekhnicheskoi Fiziki 36, 365-373 (February 1966)  
The formation of a long positive spark is accompanied by injection of a certain portion of the space charge into the spark gap; this results in distortion of the initial field distribution at the electrodes and affects the subsequent development of the discharge. This is true, in particular, of the charge in a corona pulse which forms at the beginning of the discharge and is capable of affecting the subsequent stages of the spark. In the first part of this work it has been shown that the distortion of the field by the corona charge pulse is a considerable one and that it should be taken into account when investigating gas discharge processes. The results of an experimental evaluation of the effect of a corona pulse on the subsequent formation of a long positive spark are presented here. 4 Refs.

Primary Keywords: Long Discharge; Corona; Field Distortion By Space Charge; Discharge Development

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8260

(DIAGNOSTICS AND INSTRUMENTATION)

## HIGH-VOLTAGE PULSE MEASUREMENT WITH A PRECISION CAPACITIVE VOLTAGE DIVIDER

M. M. Brady and K. G. Dedrick

Stanford University, Stanford, CA 94305  
The Review Of Scientific Instruments, Vol. 33, No. 12, pp 1421-1428 (12/1962).

The capacitive voltage divider can be designed to have an accurately known division ratio over a wide range of operating frequencies. A coaxial, guard-ring type geometry is described, and an analysis of possible errors due to geometrical anomalies and temperature variations is given. Due to the particular method of construction used, the division ratio of the divider itself is essentially independent of the dielectric constant of the dielectric oil used. Bridge circuits and their pertinent equations for calibrating the divider are presented. An experimental divider designed to operate on pulsed voltages up to 350 kV is described, having an over-all division ratio of 10<sup>2.5</sup> with  $\pm 0.8$  with an expected temperature dependence of 0.01%/Deg.C. 11 Refs.

Primary Keywords: Capacitive Divider; Coaxial Geometry; Guard Ring; Error Analysis; Temperature Effects; Experiment; Theory

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8262

(BREAKDOWN STUDIES)

## LONG HIGH-PRESSURE ARCS

E. S. Borovik, R. V. Mitin and Yu. R. Knyazev  
Soviet Physics-Technical Physics, Vol. 6, No. 11, pp 968-973 (03/1962).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 31, 1329-1338 (November 1961)  
An apparatus for the generation of long arcs (up to 8 cm long) at pressures of several tens of atmospheres is described. The arc is stabilized by rotation of the gas surrounding the arc. The plasma temperature, calculated with the aid of the equations for the electrical conductivity of the plasma and the energy balance in the arc column, was 2.2 eV Deg.K. for a power consumption of 2E5 W/cm.cm. 10 Refs.

Primary Keywords: Long Arc; High-pressure Arc; Stabilized Arc; Surrounding Gas Rotation; Energy Balance; Pinching

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8264

(BREAKDOWN STUDIES)

## MEASUREMENT OF IONIZATION AND ATTACHMENT COEFFICIENTS IN SULPHUR HEXAFLUORIDE IN UNIFORM FIELDS

M. S. Bhalla and J. D. Crooks

University of Liverpool, Liverpool, UK  
Proceedings Of The Physical Society, Vol. 80, pp 151-160 (07/1962).  
The growth of pre-breakdown currents in uniform field conditions in sulphur hexafluoride at different pressures for values of E/P in the range of 90 to 160 V/Torr-cm (5-200 mmHg pressure) indicated very large electron attachment. It is assumed that the mechanism of negative ion formation is due to dissociative attachment; therefore values of alpha and the dimensionally equivalent attachment coefficient etc have been computed from the semi-logarithmic plots of current against electrode separation by employing the modified Townsend equation for the growth of current. Further, static breakdown potentials have been measured up to a value of pd (pressure x gap length) approximately 400 mmHg cm, and a comparison with the data for dry air gives the relative dielectric strength of SF/sub 6/ as about 2.8 at 380 mmHg cm. 19 Refs.

Primary Keywords: Ionization Coefficient; Attachment Coefficient; SF/sub 6/ Gas; Current Measurement; Comparison With Air

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8265

(BREAKDOWN STUDIES)

## MICROPARTICLE-INITIATED VACUUM BREAKDOWN-SOME POSSIBLE MECHANISMS

(Vacuum, Particle)  
M. M. Manon and K. D. Srivastava  
University of Waterloo, Waterloo, Ontario, Canada  
Journal Of Applied Physics, Vol. 45, No. 9, pp 3832-3836 (09/1974).  
It is known that microparticle-initiated metal particles are released from the electrode surfaces when a vacuum gap is subjected to a high DC stress. It is also well known that larger particles (>10 micron) are generated within the interelectrode gap when a vacuum gap is subjected to conditioning or severe prebreakdown current flow. This paper examines the role of such particles in inducing the breakdown of a vacuum gap. While the larger particles induce breakdown by way of a trigger discharge, it is shown that the smaller particles can initiate breakdown because of effects associated with impact. The various effects associated with the high speed impact of a metallic microparticle on a target electrode, i.e., cratering, production of metal vapor, and production of thermally generated plasma and their relative significance on vacuum breakdown, are examined. 11 Refs.

Primary Keywords: Particle Initiated Breakdown; Electrode Particle Source; DC Voltage; Prebreakdown Current; Discharge Initiation Mechanism

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4272 (BREAKDOWN STUDIES; INSULATION, MATERIAL)  
(Gas, Electrical; Gas)  
SOME MEASUREMENTS OF THE RELATIVE DIELECTRIC STRENGTH OF GASES  
H. R. McCormick and J. D. Craggs  
University of Liverpool, Liverpool, UK  
British Journal of Applied Physics, Vol. 5, pp 171-173 (05/1954).  
Measurements of the breakdown voltages of small sphere gaps in  
various gases have been made, partly to check existing results but  
also to provide data for the various electro-negative gases, such as  
chlorine, CCl<sub>4</sub>, CBr<sub>4</sub>, etc., which were studied, taking nitrogen as a  
standard gas, and the data are tabulated. A brief discussion of these  
results is given. 18 Refs.  
Primary Keywords: Gas Breakdown; Several Gases; Breakdown Voltage;  
Nitrogen Gas; Electronegative Gases; Hydrogen;  
Chlorine; Variable Gap Spacing  
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4278  
(SWITCHES, CLOSING; SWITCHES, CLOSING)  
(Gas Gaps, Electrical; Gas Gaps, Thermal)  
THE BREAKDOWN MECHANISM OF CERTAIN TRIGGERED SPARK GAPS  
T.E. Froedbert  
University of Manchester, Manchester, UK  
British Journal Of Applied Physics, Vol. 8, pp 37-40 (01/1957).  
Experiments designed to investigate the breakdown mechanisms of certain triggered spark gaps, in air, are described. Possible theories of the breakdown mechanism of the trigatron and the thermally triggered spark gap are put forward, based on experimental voltage and time lag to breakdown characteristics, corona measurements, and on optical studies using a photomultiplier. It is shown that the mechanism of breakdown for the two types of triggered spark gap may be similar and depend on the relative charging polarities, on the movement of positive ions followed by a streamer process, and, in the case of negative charging polarities, on a streamer process only.  
9  
Refs.  
Primary Keywords: Spark Gap; Air Gap; Trigatron; Thermally Triggered Spark Gap; Breakdown Mechanism; Streamer; Experiment; Theory  
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**8279**  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Electrodes; Liquid Gaps; Materials)  
THE MECHANISM OF ELECTRICAL EROSION OF METALS IN LIQUID DIELECTRIC MEDIA  
B.N. Zolotkh  
Soviet Physics-Technical Physics, Vol. 4, No. 12, pp 1370-1373  
(06/1969)  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 29, 1484-1486 (December 1959)  
The nature of the forces responsible for the ejection of metal from craters created on the surface of electrodes under the effect of impulse discharge is not yet completely known. High-speed photography of the erosion process has made it possible to obtain new information concerning these forces. We photographed the erosion process resulting from a single discharge in kerosene lasting 180 microseconds. We used a unipolar current impulse; the value of the maximum current was 1000 amperes; the spark gap was 30 microns; the value of maximum voltage was 200 volts; the energy of the impulse was 2.5 joules. The anode was a copper plate 0.1 mm thick; the cathode was a copper wire 1 mm in diameter; the electrodes were placed at an angle of 90 Deg to each other. 3 Refs.  
Primary Keywords: Electrode Erosion; Kerosene Gap; Impulse Voltage; Photographic Diagnostic; 1000 A Current; Point-plane Gap  
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**8280**  
(BREAKDOWN STUDIES)  
(Electrodes)  
THE VAPORIZATION OF THE CATHODE IN THE ELECTRIC ARC  
R. Main  
Stockholm Carbon Co., St. Marys, PA  
Journal Of Applied Physics, Vol. 20, No. 7, pp 715-716 (07/1949)  
Calculations are carried out which show that, because of the smallness of the cathode spot, the cathode is not able to dissipate the heat generated with heavy currents by conduction. Therefore, a much higher vaporization of cathode material per coulomb occurs for heavy currents than for low currents. 9 Refs.  
Primary Keywords: Electrode Erosion; Cathode Spot; Metal Vaporization; Low Current; High Current; Comparison; Theory; Energy Balance  
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**8281**  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
TIME-RESOLVED RADIAL TEMPERATURE PROFILES FOR 10 KA SF/SUB 6/ ARCS  
D.R. Airev, P.M. Richards and J.D. Swift  
Marchwood Engineering Lab., Southampton, UK  
Journal Of Physics D: Applied Physics, Vol. 8, No. 16, pp 1982-1993  
(11/1975)  
Radial temperature profiles for pulsed SF/sub 6/ arcs burning in high-pressure, approximately 5 bar, supersonic gas flow have been measured for discrete current levels in the range 10 kA-1.0 kA. The current pulse was a 10  $\mu$ s half-sine wave and all the temperature measurements were carried out as the current decayed from 10 kA towards zero. The temperature distribution was obtained by comparing the calculated and measured emission intensities of spectral lines due to excited fluorine and ionized sulphur in local thermodynamic equilibrium. No evidence has been found for the sulphur/fluorine demixing effect previously reported in steady, free-burning, cascade arcs, but strong column instabilities have been observed. The temperature profiles were measured for times when the arc exhibited reasonable radial symmetry. The results for currents above 3.5 kA show that the axis temperature is 20000 Deg.K  $\pm$  1000 Deg.K and is independent of the arc current. Also the temperature profile is essentially parabolic, and any increase in arc current is accompanied by a corresponding increase in arc cross section to maintain a constant current density. Below 3.5 kA the axis temperature falls rapidly with current down to 15500 Deg.K  $\pm$  1000 Deg.K and the temperature profiles show very steep temperature gradients less than 1 mm from the arc axis. 22 Refs.  
Primary Keywords: SF/sub 6/ Breakdown; Radial Temperature Profile; 5 Bar Pressure; Supersonic Gas Flow; 1-10 kA Current Range  
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**8282**  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
TIME-RESOLVED SPECTROSCOPY OF SPARK DISCHARGES  
F. Tsui  
University of Liverpool, Liverpool, UK  
British Journal Of Applied Physics, Vol. 3, pp 139-140 (05/1952)  
Using a rotating mirror and a spectrometer, the spectra of the light emission from spark discharges in several gases have been photographed at different instants after the current-initiation. By triggering the discharge recurrently in synchronism with the mirror, the time-resolved spectral images of a number of sparks were superimposed to obtain sufficient blackening on the photographic plate. The triggering circuit was activated by the rotating-mirror, and, when provided with a counter, the system could be left in automatic operation. 1 Refs.  
Primary Keywords: Spark Discharge; Spectroscopy; Rotating Mirror; Streak Camera; Several Frames; Image Averaging; Several Gases; Tungsten Electrodes; Point-point Gap; 200 A Current  
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**8283**  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Electrodes; Gas Gaps; Materials)  
VAPORIZATION OF METAL ELECTRODES BY PULSED CURRENTS  
G.S. Belkin  
Pascow Power Institute, Moscow, USSR  
Soviet Physics-Technical Physics, Vol. 13, No. 9, pp 1256-1260  
(03/1969)  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 38, 1545-1551 (September 1968)  
Experiments have shown that the mass of metal vaporized from a copper cathode at currents less than 40 kA in helium at a pressure of 1 atm is proportional to the charge and is given by  $M_{\text{sub}} \propto \sqrt{t}$  (0.6-1.2)  $\times 10^{-5}$  g/C. In this case the anode loss is many times smaller than the cathode loss. The constancy of  $M_{\text{sub}} \sqrt{t}$  for large current variations is explained by the fact that vaporization of a copper cathode occurs at individual spots of currents less than 40 kA. At currents greater than 150 kA, the ratio of the mass of vaporized metal to the integral of  $i dt$  can be 30-40 times greater than  $M_{\text{sub}} \sqrt{t}$  for a copper cathode at currents smaller than 40 kA. At high currents vaporization occurs not only from cathode spots, but from the entire surface of the electrode covered by the spots. For this reason a marked increase in the mass of vaporized metal is possible at currents above 150 kA. Calculation of the mass of vaporized metal, averaging the thermal flux over the area of the electrode covered by spots (allowing for the increase in path cross section by the end of the discharge), gave a value of 24 mg for a current of 500 kA with a period of 140 microseconds and a damping factor of 8.7E3/sec; the experiment gives 32 mg. 11 Refs.  
Primary Keywords: Electrode Erosion; Copper Cathode; Helium Gas; Atmospheric Pressure; 150 kA Current; Dependence On Charge Transfer; Cathode Spot  
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**8284**  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
VOLTAGE-TIME CHARACTERISTIC OF ELECTRICAL BREAKDOWN IN SF/SUB 6/  
T. Nitta, Y. Shibuya and Y. Fujiwara  
Hitachi, Electric Corp., Amasaki, Japan  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-94, No. 1, pp 108-115 (02/1975)  
V-t characteristic of impulse and switching surge breakdown in SF/sub 6/ is studied on various gaps. The characteristic is categorized into three patterns depending on the configuration of the gap and gas pressure. The properties of the V-t characteristic in these patterns are generalized as a semi-empirical formula which will be useful in the quantitative evaluation of the insulation coordination and the abnormal voltage protection of SF/sub 6/ gas insulated power equipments. The gap conditions in which these patterns of V-t characteristic are observed are also discussed in the Appendices. 15 Refs.  
Primary Keywords: SF/sub 6/ Breakdown; Voltage Measurement; Semi-empirical Formula; Sphere-sphere Gap; Corona Stabilization  
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**8285**  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
WIDEBAND HIGH VOLTAGE PROBE  
R. Keller  
Lab de Recherches sur la Physique Des Plasmas, Lausanne, Switzerland  
The Review Of Scientific Instruments, Vol. 35, No. 3, pp 1057-1060  
(08/1964)  
A high voltage probe is described which is based on the principle of consecutive differentiation and integration. The voltage to be measured is applied to a coupling capacitor of a few picofarad and related at several tens of kilovolts. The capacitor is connected to a cable which propagates a signal proportional to the derivative of the voltage. At the other end of the cable a transistorized integrator integrates the current and produces a signal proportional to the voltage. It is thus possible to obtain a bandwidth of 300 Hz to 200 MHz. 6 Refs.  
Primary Keywords: Differentiating Probe; Integrating Sensor; 70 kV Operating Voltage; 200 MHz Bandwidth  
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**8286**  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
CATHODE SPOTS IN THE TRANSIENT GLOW DISCHARGE IN NITROGEN  
D. Farish and D.J. Tedford  
University of Strathclyde, Glasgow, Scotland  
British Journal Of Applied Physics, Vol. 17, pp 965-966 (07/1966)  
Cathode spots, arranged in a regular pattern of concentric circles, have been observed to occur during the transient glow discharge stage of the impulse breakdown of uniform field gaps in nitrogen. 3 Refs.  
Primary Keywords: Glow Discharge; Nitrogen Discharge; Cathode Spot; Spot Pattern; Copper Electrodes; Nickel Plating  
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**8287**  
(REVIEWS AND CONFERENCES; INSULATION, MATERIAL)  
(Reviews; Reviews)  
INSULATING MATERIALS FOR DESIGN AND ENGINEERING PRACTICE  
F.M. Clark  
General Electric Co., Schenectady, NY 12301  
Publisher: John Wiley And Sons, Inc., New York (01/1962)  
Mr. Clark has produced a very thorough treatise on insulation in this book. The book begins with a short review of the purpose of insulation and some of the constraints and proceeds to consider in depth several of the important aspects of insulating systems: design and maintenance. The book includes chapters on insulating material selection, writing specifications, long-term temperature and environmental effects, and manufacture and maintenance. Complete characterization of many gaseous, liquid, solid, and composite insulation systems are a very important part of the book. Breakdown mechanisms are discussed. Pulsed voltages are not considered extensively. 1709 Refs.  
Primary Keywords: Material Insulation; Review; Insulation Selection; Insulation Maintenance; Environmental Effects; Insulation Characterization; Gaseous Insulation; Liquid Insulation; Solid Insulation; Insulation Systems  
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8288  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Liquid, Electrical; Ignitrons, Materials)  
FIELD ELECTRON EMISSION FROM LIQUID MERCURY

J.M. Beams  
University of Virginia, VA  
Physical Review, Volume 44, pp 803-807 (11/1933).  
Field emission from liquid mercury has been investigated by applying an impulsive potential of approximately  $10^{-6}$  sec. duration between a spherical steel anode and a plane mercury cathode. The field just necessary to produce breakdown gave a measure of the field necessary to produce emission because rotating mirror photographs showed that the field emission from the cathode initiated the discharge. The liquid mercury cathode was cooled to a few degrees above its freezing point and the mercury vapor pressure still further reduced by solid CO<sub>2</sub> sub 2 traps. The mercury could be distilled repeatedly in vacuo and the surface of the cathode changed by "overflowing". The electric field necessary to produce sufficient field emission to start the discharge depended upon the purity of the mercury surface. It varied from 3.5E6 volts per cm for impure mercury to 1.8E6 volts per cm for mercury that had been repeatedly distilled in vacuo. 17 Refs.  
Primary Keywords: Field Emission; Mercury Surface; Spherical Anode; Steel Anode; Variable Purity  
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8289  
(BREAKDOWN STUDIES)  
(Liquid, Electrical)  
A THEORY OF LIQUID SURFACE RUPTURE BY A UNIFORM ELECTRIC FIELD

L. Tonks  
General Electric Co. Schenectady, NY 12301  
Physical Review, Vol. 48, pp 562-568 (09/1935).  
Surface distortion and rupture permits field emission from liquid surfaces at field strengths less than those effective for equally smooth solid surfaces. An approximate mathematical theory of the rupture of a plane liquid surface in a uniform electric field has been developed. The relation between initial distortion, rupture time, and field strength has been calculated for fields which are large when compared to that which just renders the surface unstable. Typically, the theory shows that a hump initially  $4E-5$  cm high and of diameter  $9E-6$  cm will lead to rupture in  $5E-6$  sec. in a field of  $1E6$  V/cm. Relative to initial humps in the surface, the linear dimensions vary inversely as the square of the field; the time to rupture varies inversely as the cube of the field strength. This calculation shows that a lowered sparking potential to liquid mercury can be ascribed to surface rupture and shows that it is possible that surface rupture plays a part in Beams' low field emission from liquid mercury. Possible application of the theory to the high field condition at the cathode spot of the Mg arc is not clear. 4 Refs.  
Primary Keywords: Liquid Surface Distortion; Surface Rupture; E-field Strength; Rupture Theory  
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8292  
ADVANCED CONCEPTS FOR PHOTON SOURCES: VOLUME 2. FAST SWITCHING OF VACUUM MAGNETIC ENERGY STORES

V. Bailey, L. Demeter, J. Benford, A. Hoeth and D. Sloan  
Physic International Co. San Leandro, CA 94577  
Final rept. Sep 72-Jul 73 No. PIFR-398-Vol-2, 228p (10/1973).  
Availability: AD-A015 386/65T  
NTIS  
Inductive (magnetic) energy storage systems are analyzed in terms of their application to generation of ultra-high power pulses. Such systems can transform low-power energy inputs into high-power outputs (power multiplication) by shortening the energy delivery time. Energy transfer from magnetic store to resistive load can approach 100 percent efficiency. Models of several accelerated metallic plasma transfer switch geometries indicate that such switches can be energetically efficient and can produce substantial voltage multiplications. Using a versatile and extensively diagnosed apparatus, experiments were conducted to test these predictions. The experiments confirmed the modeling and established design criteria for metallic wire plasma switches. Operating at 25 kJ energy level, a coaxial switch produced narrow (68 to 300 nsec) voltage spikes with voltage and power multiplications of 5.  
Primary Keywords: Energy Storage; Power Supplies; Pulse Generators; Magnetic Cores; Vacuum; Arcs; Switching Circuits; Plasma Devices  
Secondary Keywords: Inductive Energy Storage; Magnetic Energy Storage; NTISDOD-D

8297  
(ENERGY STORAGE, CAPACITIVE)  
(Capacitors)  
ADVANCED SIMULATION RESEARCH: VOLUME II. VACUUM ENERGY STORAGE

M. Clark, P. Kern, A. Mondelli and M. Rostoker  
Maxwell Labs Inc. San Diego, CA 92123  
Final rept. 1 Aug 74 31 Jul 75 No. MLR-498, 150p (09/1973).  
Availability: AD-A048 152/05T  
NTIS  
The STP experiment has been placed in operation during this contract period. A number of electron injectors have been explored with the injected charge shown to scale linearly with the injector bias voltage. Injected charge levels approximately 100 microcoulombs, which corresponds to potential well depths of approximately 300 kV, have been measured as will be described in this report. Vertical magnetic field coils have been installed on the experiment, and preparations for high-energy electron injection have been completed. Theoretical studies of high-energy injection, including single-particle and fully-relativistic self-consistent calculations, are presented. In addition, a theoretical study of switching energy stored in the torus is reported. (Author)  
Primary Keywords: Energy Storage; Electron Beams; Particle Accelerators; Toroids; Magnetic Fields; Simulation; High Voltage; Vacuum; High Energy  
Secondary Keywords: Charge Injection; STP Experiment; NTISDODXA

8300  
(POWER CONDITIONING)  
(Pulse Forming Networks)  
CONTROL OF THE SHAPE OF HIGH-CURRENT, HIGH-VOLTAGE PULSES GENERATED BY AN ARTIFICIAL LINE

L.I. Pivovarov and E.G. Teller  
Sandia Report No. SAND-77-6016 (09/1975).  
Trans. From: KHFTI-73-20, pp 57-58 By P. Newman  
Availability: SAND-77-6016  
NTIS  
Several devices used in plasma physics, accelerator technology, etc., are supplied by current and voltage pulses of rectangular shape. When the load is variable or nonlinear, circuits containing active and passive loops incorporating a time delay are used to obtain the required pulse shape. These circuits are so expensive and time-consuming to design and develop that it is desirable to develop a way to model them on a computer. Calculations necessarily include some simplifications, since some parameters can only be determined precisely by physical measurements on the finished device. The solution is described. (ERA citation 03:007763)  
Primary Keywords: Accelerators; Power Supplies; Thermodynamic; Reactors; Control Systems; Electronic Circuits; Pulse Shapers; Pulses; Shape  
Secondary Keywords: ERDA/700203; ERDA/430300; Translations; USSR; Delay Circuits; Computerized Simulation; NTISDEI

8302  
(PULSE GENERATORS)  
( )  
DEVELOPMENT AND USE OF 60 KV. AND 150 KV FLOATING DECK MODULATORS FOR HIGH VOLTAGE PROTECTION OF MULTI-MEGAWATT ION BEAM ACCELERATORS

G.C. Barber, H.S. Ponte and G. Schilling  
Oak Ridge National Lab. Oak Ridge, TN 37830  
Availability: CONF-771029-67  
NTIS  
Extraction currents of 60 A at 40 kV have been produced by utilizing a 60 kV floating deck modulator interfaced to a high voltage power supply. The modulator is operated in a series mode to repetitively pulse power to the ion beam accelerator. Current monitoring and other protective circuits provide interrupt commands to the series switch tube when faults occur. The constant current characteristics of the water cooled cathode and the rapid response of the protective circuits effectively limit the fault energy to the ion source. Three of the 60 kV decks have been modified and stacked in a series configuration to supply 150 kV, 50 A pulses. This system supplies power for development of higher-energy multi-grid sources. In this system attention has been focused on forced voltage sharing of the three decks and on protective circuits for fault conditions. All control signal processing and conditioning is performed at ground level. Fiber optic links are used to interface with the high potential associated with the floating decks. A shunt modulator incorporated with this system provides regulation of the voltage to the ion source gradient grid. Future modulator development includes a system to deliver 100 A at 80 kV. (ERA citation 03:016254)  
Primary Keywords: Ion Sources; Switching Circuits; Electric Currents; Electric Potential; Electronic Circuits; Modulation; Neutral Atom Beam Injection; Neutral Beam Sources; Ormak Devices; Fil Devices; Power Supplies; Specifications; Beam Injection; Tokamak Devices  
Secondary Keywords: ERDA/700203; ERDA/700205; NTISDE  
Distribution Restriction: U.S. SALES ONLY

8305  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
GASEOUS DISCHARGE SWITCH IN OVERSIZED WAVEGUIDE

J.P. Quine and C. Young  
General Electric Co. Schenectady, NY 12301  
Final rept. 1 Oct 64-30 Sep 65 (02/1966).  
Availability: AD-A09 506/85T  
NTIS  
The purpose of this investigation is to develop fast ultra high power switches compatible with the TE<sub>10</sub> mode in oversized rectangular waveguide for which the height and width dimensions are of the order of two free space wavelengths. Experimental switches are to be designed for operation at X-band. This report presents the results of the theoretical and experimental investigation of the DC triggered spark gap switches for oversized Rectangular Waveguide. These switches which operate at atmospheric pressure employ a symmetrical arrangement of several spherical spark gaps in order to prevent the generation of higher order propagating modes. The results of a theoretical and experimental study of low pressure gaseous electronic switches employing a Penning type of discharge are also included. (Author)  
Primary Keywords: Waveguide Switches; X Band; Waveguides; Microwave Equipment; Gas Discharges; Electrodes; Standing Wave Ratio; Electronic Switches  
Secondary Keywords: Spark Gaps; NTISDODXD  
Distribution Restriction: DISTRIBUTION LIMITATION NOW REMOVED.

8336  
(POWER TRANSMISSION)  
(Cables)  
HIGH POWER, LOW NOISE PULSE CABLE

J. Aronius and R. Feller  
ECOM, Fort Monmouth, NJ 07703  
Availability: AD-656 503  
NTIS  
Four new types of high power, low noise rubber pulse cables have been developed that have high power handling capacities, considerable flexibility over the ambient temperature range of -55C to +55C, exhibit good corona stability after thermal cycling and effective shielding against the electromagnetic radiation emanating from these cables. A program has been established for the development of triaxial terminations for these cables. The terminations for the RG-191(U), RG-192(U), RG-193(U) and RG-194(U) pulse cables will be of the matched type and the cable assemblies will be manufactured at the factory, which will insure corona free operation and ease of assembly to the equipments. Triaxial connectors for the RG-190(U) pulse cable are currently being developed. It is anticipated that the termination for the RG-190(U), RG-191(U) and RG-192(U) pulse cables will be available by May 1957. A hydrogen thyratron test and aging experiment has been installed to experimentally verify the performance characteristics and curves based on calculated data under high pulse voltage and short pulse conditions. The equipment is capable of 1 megawatts peak power output.  
Primary Keywords: Pulse Cables; Radiofrequency Power; Electric Insulation; Butyl Rubber; Silicone Plastics; Metal Coatings; Performance(Engineering); Voltage; Attenuation; Electromagnetic Shielding; Electric Connectors; Noise(Radar); Radar Equipment



8310  
(PULSE GENERATORS, SWITCHES, CLOSING)  
(Line Type: Gas Discharge Electrical)  
PRODUCTION OF MILLIMICROSECOND CURRENT PULSES USING A PRESSURIZED SPARK GAP

J.H. Adlam and L.S. Holmes  
Atomic Energy Research Establishment, Harwell, Berkshire, UK  
Journal Of Scientific Instruments, Vol. 37, No. 10, pp 385-388  
(10/1968)

A pressurized spark gap has been designed to discharge a number of coaxial cables in parallel, thus producing a rectangular pulse of 1E6 A with a rise time of 4.5 nanoseconds. It is designed to use a number of these spark gaps in parallel, to test the feasibility of doing this, measurements have been made of the statistical variation of the time lag for breakdown after triggering. 3 Refs.

Primary Keywords: Coaxial Line Pulse Transformer; Multiple Spark Gap Switching; Nanosecond Jitter; Parallel Gap Operation; Performance Test

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8311  
(INSULATION, MATERIAL; BREAKDOWN STUDIES)  
(Solid; K: Air Flashover)

MEASUREMENTS OF THE CHARGE DISTRIBUTIONS ON AN ALUMINA INSULATOR IN VACUUM RESULTING FROM HIGH-VOLTAGE STRESS

J.P. Brinhard and D. Jensen  
Sandia Labs, Albuquerque, NM 87115  
No. CN-7301, 15p (11/1968)  
Availability: SAND 74-4355  
NTIS

For abstract, see NSA 30 09, number 26300.

Primary Keywords: Dielectric Materials; Electric Charges; Aluminium Oxides; Electric Potential; Electric Probes; High Vacuum; Measuring Methods; Stresses; Surfaces

Secondary Keywords: NTISAE0

8312  
(INSULATION, MATERIAL)  
(Solid)

METHODS FOR CREATION OF HIGH-VOLTAGE, HIGH-TEMPERATURE ELECTRIC INSULATION

V.I. Kalitvanskii, A.M. Tuchinskii, M.N. Aleksandrov, E.Z. Ananovich and V.A. Kolesnova  
Availability: GFR-TR-802  
NTIS

Methods for the production of high voltage (up to 6 kV) and high temperature (500 to 600 exp 0 C) electric insulation were studied. Insulation of this class can be produced using artificial mica and aluminophosphate. ER citation 05:010071  
Primary Keywords: Electrical Insulation; Aluminium Phosphates; Dielectric Materials; Dielectric Properties; Electrical Equipment; Fabrication; High Temperature; Mica; Performance Testing

Secondary Keywords: ERDA/200300; Translations: USSR; NTISDET  
Distribution Restriction: Translated from Elektrotekhnik 43 n5 p10-12 1972.

8314  
PARTICLE-INITIATED BREAKDOWN IN GAS DIELECTRIC CABLE INSULATION  
EXPANDED SCOPE PROGRAM (FINAL REPORT)

C.M. Cooke  
Massachusetts Institute of Technology, Cambridge, MA  
Availability: EPRI-EL-1264  
NTIS

The adverse influence of conducting particle contaminants in gas-insulated power apparatus was investigated in a series of experiments that employed coaxial configurations and dc voltages to 1500 kV. Particle dynamics was shown to be important and related to breakdown initiation in the gas. Both SF sub 6 and n sub 2 gases at pressures from 1 to 16 atm absolute were used. The particles were intentionally introduced and ranged from 1.6 to 6.4 mm spheres and wires. Effects in the gas gap as well as along surfaces of solid insulators were studied. Visual observations, photographs, and electrical measurements helped in distinguishing various processes. Particles could reduce the insulation performance by factors of 3 to 5 and were especially significant when moved to the center conductor by coordination of this work with a separate study at the Westinghouse R and D laboratory. A comparison between dc and ac performance was made. Generally the dc breakdown values exhibited wider scatter, though their lower limit was similar to that found under ac. Overall fundamental forces and processes which involve particle contamination effects were identified and found to be the same for ac and dc voltage stresses. (ER citation 05:015703)

Primary Keywords: Gas-insulated Cables; Jv; De Systems; Aluminium; Breakdown; Coaxial Cables; Comparative Evaluation; Dielectric Materials; Electric Insulation; Experimental; Data; Graphs; Nitrogen; Particles; Power Transmission Lines; Pressure Dependence

Secondary Keywords: ERDA/200302; NTISDE

8317  
(SWITCHES, OPENING)  
(Gate Turnoff Rectifier)  
POWER AMPLIFICATION WITH GATE TURN-OFF CONTROLLED RECTIFIERS

R.G. Camacho  
Naval Postgraduate School, Monterey, CA 93940  
Master's thesis (10/1968)  
Availability: AD-80 466/25T  
NTIS

With ever larger amounts of power being required by present day active sonars, studies are being made towards improving the efficiency of the power train. A gain in efficiency is possible if non-linear switching type amplifiers are used in lieu of the linear amplifiers presently used. Due to its high switching efficiency, fast switching, and ability to be turned on or off by gate signals, the Gate Turn-off Controlled Rectifier was investigated for possible application in an amplifier circuit. The circuit examined readily met the required criteria, however, the real value of this study lies in the method of predicting transient performance. Use of the derived equivalent circuit, and an analog computer model based on transfer functions (E sub 1/E and E sub 1/E), provide analytical solutions that can be arrived at more readily than by other methods. (Author)

Primary Keywords: Rectifier Amplifiers; Sonar Equipment; Rectifier Sonar Equipment; Power Amplifiers; Sonar Equipment; Gates/Circuits; Gain; Voltage; Electric Currents; Transducers; Signal Theory; Trigger Circuits; Design; Active

Secondary Keywords: Semiconductor Junctions; NTISDDYD  
Distribution Restriction: Distribution limitation now removed

8318  
(PULSE GENERATORS)  
(Maser)

PULSE CIRCUIT FOR W/SUB 2/ LASERS

O. Steinvall, A. Widen, A. Anvari and R. Nilsson  
Research Inst of National Defence, Stockholm (Sweden)  
No. TGA-2-C-2503-EL, 32p (11/1971)  
Availability: N74-132101  
NTIS

A very simple pulsed gas laser has been constructed for generating short laser pulses with high power, high repetition frequency and good stability. The system has been tested for nitrogen at 3371 A. The following data have been obtained: Pulse length 5 ns, output power 500 kW, and repetition frequency 100 nps. The cavity can be used for laser wave lengths with less reinforcement. Some of the physical parameters have also been examined, such as coherency characteristics of amplifiers and beam divergence, etc. The electrical circuit used was built on the well known Marx generator principle and can also be used as a pulses are required, for example, for producing short X-ray flashes. A disadvantage of the circuit is that it has rather many spark gaps which produce certain problems concerning flash overs. (Author)

Primary Keywords: Gas Lasers; Pulse Generators; Pulsed Lasers; Flashover; Laser Outputs; Nitrogen; Spark Gaps

Secondary Keywords: IN SWEDISH; NASA

8319  
(ENERGY CONVERSION, ELECTRICAL)  
(Power Supplies)

SEMICONDUCTOR MEASUREMENT TECHNOLOGY: A VERSATILE HIGH-VOLTAGE BIAS SUPPLY FOR EXTENDED RANGE MIS (CV) AND GIV) MEASUREMENTS

P.H.H.O. Kuczer and A.M. Goodman  
RCA Labs, Princeton NJ 08540  
Special rept. (12/1977)  
Availability: PB-274 939/BST  
NTIS

Recently developed technology has enabled the measurement of MIS (CV) and GIV) at bias-voltage magnitudes as large as 25 kV. This report describes a versatile high-voltage power supply intended for use as a bias source in carrying out such measurements. The design allows the user a wide variety of options in the selection of the sweep function (waveform), sweep time, initial bias voltage, and the amplitude of the bias sweep. There are six possible sweep functions: (1) increasing ramp, (2) decreasing ramp, (3) positive polarity half-wave sawtooth (increasing ramp followed by decreasing ramp), (4) negative polarity half-wave sawtooth (decreasing ramp followed by increasing ramp), (5) full-wave sawtooth starting with increasing ramp, and (6) full-wave sawtooth starting with decreasing ramp. Either single or repetitive sweeps may be selected. The sweep time from the initial value to the end of the first ramp segment may be varied from 1 to 2000 s. Operator convenience is enhanced by certain features of the design, among these are light-emitting diodes which display the state of the sweep and automatic pen control if the sweep is used with an x-y recorder.

Primary Keywords: Semiconductors; Measurement; Power Supplies; High Voltage; Bias; Capacitance; Electrical Resistance; Function Generators; Semiconductor Devices; Sweep Circuits; Electric Measuring Instruments

Secondary Keywords: Metal Insulator Semiconductors; Silicon On Sapphire; NTISCOMN85; NTISDDDS

8321  
(BREAKDOWN STUDIES)  
(Exploding Wires)

STRIATIONS IN EMP  
H. Gorenkin  
Temple University, Philadelphia, PA 19122  
Doctoral thesis No. Scientific-2, 19p (10/1968)  
Availability: AD 685 174  
NTIS

Striations in exploding wires have been examined in sequential frame studies to investigate the possibility that gas discharge type striations are formed in the electron-vapor sheath. These electrical striations, due to localized space charge formed by impact, move in the direction of major electric current carrier motion. Experiments were carried out on samples immersed in distilled water in order to impede outgassing which could mask striations. No. 28 copper wire samples in 1 and 2 cm lengths were connected across a 45 microfarad capacitor bank charged to 3 to 8 kV. Within the range of electric fields used in this experiment, no movement of striations were observed. Comparison of striations in annealed and unannealed wires show that it is not likely that low velocity striations are present. The existence of mechanical striations has been firmly as established. (Author)

Primary Keywords: Exploding Wires; Electric Fields; Gas Ionization; Ionization Potentials; Vaporization; Charged Particles; Thesis

Secondary Keywords: EMP(Exploding Wire Phenomena); Exploding Wire Phenomena; Mechanical Striations; Electrical Striations; Striations

8322  
(PARTICLE BEAMS, NEUTRAL)  
(Generation)  
STUDY OF EFFICIENT HIGH-POWER, HIGH-ENERGY NEUTRAL BEAMS FOR THE REFERENCE MIRROR REACTOR

J.H. Fink, W.L. Barr and G.W. Hamilton  
Lawrence Livermore Lab, Livermore, CA 94550  
(11/1976)  
Availability: UCRL-52173  
NTIS

An injector design for the Reference Mirror Reactor is described which uses negative ions created by charge-exchange in a cesium vapor cell and neutralized by photodetachment. Some of the innovations discussed include a continuously operating cathode for an LBL/LLL ion source, a negative ion beam line with cooled grids, a high voltage accelerator configuration with insulators shielded from the neutron and gamma flux, and cryopanels which continuously cycle between pumping and outgassing modes. (ER citation 02:031659)

Primary Keywords: Magnetic Mirror Type Reactors; Neutral Atom Beam Injectors; Cathodes; Design; Efficiency; Electrodes; Ion Sources; Performance

Secondary Keywords: ERDA/200205; NTISERDA

8324  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
THE EFFECT OF HUMIDITY ON A CORONA DISCHARGE IN AIR  
B.R. Maskell  
Royal Aircraft Establishment, Farnborough, UK  
No. RAE-TR-70106, 27p (06/1970).  
Availability: NTIS 71-24373

Primary Keywords: Electric Corona; Humidity Measurement; Moisture  
Meters; Atmospheric Moisture; High Voltages;  
Pressure Effects; Response Time (computers);  
Temperature Effects; Volt-ampere Characteristics

8325  
(BREAKDOWN STUDIES)  
(Gas, Optical)  
THE GUIDANCE OF HIGH-VOLTAGE ELECTRICAL BREAKDOWN STREAMERS BY LASER  
INDUCED IONIZATION IN AIR

Markels  
Versar Inc. Springfield, VA 22151  
Final scientific rept. (06/1973).  
Availability: AD-763 827  
NTIS

Experimental studies and theoretical analysis have shown that the  
breakdown paths and propagation velocity of high voltage electrical  
streamers can be modified and controlled by laser radiation at  
intensities less than the optical breakdown threshold. In air at  
atmospheric pressure, 450 kV negative streamers have been guided  
along straight paths about 70 cm in length, and the propagation  
velocities of the streamers have been increased from 2 x 10 to the  
power of 7 cm/sec to 3 x 10 to the power of 8 cm/sec, by 1.06  
micrometer radiation pulses of 200 Joules energy and 60 nsec  
half-width. Direct measurements of the degree of ionization along  
the laser beam path showed about 10 to the power of 10 - 10 to the  
power of 11 ion pairs/cc are produced at the beam intensities used in  
the studies. (Modified author abstract)

Primary Keywords: Gas Ionization; Coherent Radiation; Electric  
Discharges; Lasers; Optical Equipment; Electrodes;  
Recombination Reactions; Ions; Electron Density  
Secondary Keywords: Laser Beams; Dielectric Breakdown; Q Switched  
Lasers; Nuclear Fusion; AF

8326  
(ENERGY STORAGE, MECHANICAL)  
(Rotating Machines)  
THEORETICAL AND EXPERIMENTAL STUDY OF THE CURRENT DISTRIBUTION IN COILS  
COUPLED TO IMPULSE DYNAMOS

B. Geoffroy and M. Legentil  
Paris University, Orsay, France  
No. LF-10, 29p (03/1973).  
Availability: NTIS 74-174566

The features of coils to be coupled to homopolar impulse  
generators were determined in order to maximize transfer efficiency  
from kinetic to magnetic energy. The current distribution inside the  
coils was computed, together with the resulting magnetic induction,  
and a comparison was made with experimental results obtained using a  
5 MJ generator. (Author)

Primary Keywords: Electric Energy Storage; Energy Conversion  
Efficiency; Impulse Generators; Magnetic Coils;  
Current Distribution; Electrical Engineering; High  
Voltages; Impedance; Magnetic Induction; Time  
Dependence  
Secondary Keywords: NASA

8329  
(POWER CONDITIONING)  
(Pulse Forming Networks)  
A PULSE-FORMING NETWORK FOR PARTICLE PATH VISUALIZATION

K.W. McCallister  
Aes Research Center, Moffett Field, CA  
Technical memo. No. NASA-A-8671, 18p (11/1981).  
Availability: AD-A108 424/3  
NTIS

A procedure is described for visualizing nonsteady fluid flow  
patterns over a wide velocity range using discrete nonluminous  
particles. The paramount element responsible for this capability is a  
pulse-forming network with variable inductance that is used to  
modulate the discharge of a fixed amount of electrical energy through  
a xenon flashtube. The selectable duration of the resultant light  
emission functions as a variable shutter so that particle path images  
of constant length can be recorded. The particles employed as flow  
markers are hydrogen bubbles that are generated by electrolysis in a  
water tunnel. Data are presented which document the characteristics  
of the electrical circuit and establish the relation of particle  
velocity to both surface inductance and film exposure. (Author)

Primary Keywords: Pulse Generators; Electrical Networks; Meter  
Journals; Flash Lamps; Xenon Lamps; Flow Fields;  
Particles; Paths; Shutters (Optics); Images; Bubbles;  
Patterns; Hydrogen; Electrolysis; Exposure (General);  
Functions; Films; Electricity; Circuits; Light  
Pulse Forming Networks; Flow Visualization;  
Secondary Keywords: Unsteady Flow; Streamline Visualization;  
NTISDODXA, NTISNASA; NTISDODA

8337  
(SWITCHES, CLOSING)  
( )  
DEVELOPMENT OF HIGH VOLTAGE-HIGH CURRENT SWITCHES (FINAL REPORT)  
H.M. Price  
General Electric Co. Schenectady, NY 12301  
No. NASA-GP-61519, 48p (02/1966).  
Availability: NTIS 71-17073

Primary Keywords: Electrical Properties; High Voltages; Switches;  
Trigger Circuits; Tube Anodes; Vacuum Tubes;  
Electric Potential; Envelopes; Hydrogen Plasma;  
Ignitrons; Tube Cathodes

8347  
(ENERGY STORAGE, MECHANICAL)  
(Rotating Machines)  
FDX: A FAST DISCHARGE HOMOPOLAR GENERATOR  
H.M. Woodson (1), D.J. Mayhall (1) and M.O. Rylander (2)  
(1) University Of Texas At Austin, Austin, TX 78712  
(2) Department Of Energy  
No. CONF-771132-4, 12p (01/1977).  
Availability: NTIS 71-5594-8

A study was undertaken to determine the fundamental limitations to  
the discharge times of homopolar generators. As a result of the  
study, a Fast Discharge Experiment (FDX) was proposed. FDX is a small  
(365 kJ), counterrotating disk type homopolar generator designed to  
explore the limits to homopolar generator discharge times. The FDX  
rotors are forged aluminum alloy with flame sprayed copper slip  
rings. Solid copper graphite brushes are used with a 95% packing  
factor on the slip rings. The high magnetic field required for fast  
discharge (3.6 T average) is provided by discharging the CEM 5.0 MJ  
homopolar generator into a four-turn, graphite-reinforced, room  
temperature copper coil. Since the field is pulsed and FDX rotors  
cannot be self motored, they are brought up to speed with two 37 kW  
air turbines. The two aluminum rotors are 30 cm in diameter and of a  
rimmed, modified constant stress configuration. They are designed for  
a maximum operating speed of 28,000 r/min at which point they each  
store 182.5 kJ and develop 104 V. The aluminum discharge cox is  
approximately 38 cm in diameter and is designed to carry the 1.88 MA  
anticipated from a half speed (14,000 r/min) short circuit discharge  
which would stop the rotors in 1.8 ms. It is predicted that the  
machine will ring on its own internal inductance for approximately  
five cycles in this mode. The discharge cox is shorted by four very  
fast making switches.

Primary Keywords: Electric Generators; Thermonuclear Reactors;  
Aluminum; Configuration; Gas Turbines; Operation;  
Rotor Specifications  
Secondary Keywords: ERDA/700203; DC Generators; Fast Discharge  
Experiment; NTISDE

8355  
(ENERGY STORAGE, MECHANICAL)  
(Rotating Machines)  
HOMOPOLAR GENERATOR DEVELOPMENT AT THE UNIVERSITY OF TEXAS  
W.F. Meldon (1), H.M. Woodson (1) and Rylander M.O. (2)  
(1) University Of Texas At Austin, Austin, TX 78712  
(2) Department Of Energy  
No. CONF-771132-3, 9p (01/1977).  
Availability: NTIS 71-5594-7

Homopolar generator development since 1972 is reviewed. The first  
homopolar generator stored 0.65 MJ was capable of self motoring to  
6000 r/min in about 12 min with an armature current of 1.0 KA and  
could discharge in about 3.0 s at a current of 14.0 KA. A high brush  
tester to evaluate mechanical and electrical properties of the  
various grades of solid brushes available is mentioned. The second  
homopolar generator stores 5.0 MJ of energy inertially at 5600 r/min  
and is basically a scaled-up version of the first generator with  
improved bearings and brush mechanism. Work on fast discharge and  
industrial programs is mentioned. (ERA citation 03:025509)

Primary Keywords: Electric Generators; Thermonuclear Reactors; Design;  
Fabrication; Operation; Performance Testing; Power  
Supplies; Specifications  
Secondary Keywords: ERDA/700203; DC Generators; NTISDE

8361  
(ENERGY STORAGE, MECHANICAL)  
(Rotating Machines)  
MODEL AIR-SUPPORTED DRUM-TYPE HOMOPOLAR GENERATOR  
R.L. Kuston, R.E. Fuje, R.B. Wehrle, R.P. Smith and T.J. Kovarik  
Argonne National Lab, Argonne, IL  
(01/1977).  
Availability: CONF-771132-6

A single cylinder, drum-type homopolar generator has been designed  
and built for the purpose of developing a simple air support system  
for thin cylinder rotors operated at high surface velocities and  
significant radial drum growth. The model has an aluminum cylinder  
which is 0.32 cm thick, 25 cm in diameter, and 12.7 cm long. It is  
designed to operate at a peak current of 2500 A and to store a total  
of 40 kJ with a surface velocity of 305 m/sec. (ERA citation  
03:049215)

Primary Keywords: Electric Generators; Air; Cylindrical Configurations;  
Design; Electric Contacts; Levitation; Power  
Supplies; Rotation; Thermonuclear Reactors  
Secondary Keywords: ERDA/700203; DC Generators; NTISDE

8363  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
OPTICAL METHODS OF ELECTRICAL MEASUREMENT AT HIGH VOLTAGE LEVELS  
R.E. Hehner, R. Malewski and E.C. Cassidy  
National Bureau of Standards, Washington, DC  
Final rept. (11/1977).  
Availability: NTIS 71-282 879/65T

Optical methods to measure electric parameters and transmit the  
information from high voltage circuits to ground potential are  
described and evaluated in the light of the specific requirements of  
high voltage measurement applications. The history and physics of a  
variety of optoelectrical methods found suitable for electrical  
measurement applications are introduced. Existing optical devices for  
measuring alternating, direct, and impulse currents and voltages in  
high voltage circuits are reviewed with emphasis on the operation and  
features of several selected methods. The use of these techniques in  
high voltage and industrial power systems, in research laboratory  
apparatus, and in reference standards laboratories is discussed.

Primary Keywords: Electrical Measurement; Optical Measuring  
Instruments; High Voltage; Faraday Effect; Kerr  
Magneto-optical Effect; Electrooptics; Birefringence  
Secondary Keywords: NTISCOMH85  
Distribution Restriction: IN PROCEEDINGS OF IEEE, V63 N11  
P1524-1548 NOV 77.

8367  
(REVIEWS AND CONFERENCES: PARTICLE BEAMS)  
(Conferences: Reviews)  
PROCEEDINGS OF THE INTERNATIONAL TOPICAL CONFERENCE ON HIGH POWER  
ELECTRON AND ION BEAM RESEARCH AND TECHNOLOGY (2ND), OCTOBER 3-5, 1977;  
VOLUME I

J.A. Nation and R.M. Sudan  
Cornell University, Ithaca, NY 14850  
Final rept. (03/1978).  
Availability: AD-A057 218/857  
NTIS

Contents: Generation and Transport of Intense Beams; Energy  
Deposition in Targets; Beam Plasma Interactions; and Charged Particle  
Rings.

Primary Keywords: Electron Beams; Ion Beams; Particle Accelerators;  
High Energy; Nuclear Fusion; Confinement (Nuclear  
Reactors); Implosions; Ion Bombardment;  
Plasmas (Physics); Heating; Symposia

Secondary Keywords: Storage Rings; Meetings; NTISDDXA

8368  
(REVIEWS AND CONFERENCES: PARTICLE BEAMS)  
(Conferences: Reviews)  
PROCEEDINGS OF THE INTERNATIONAL TOPICAL CONFERENCE ON HIGH POWER  
ELECTRON AND ION BEAM RESEARCH AND TECHNOLOGY (2ND), OCTOBER 3-5, 1977;  
VOLUME II

J.A. Nation and R.M. Sudan  
Cornell University, Ithaca, NY 14850  
Final rept. (03/1978).  
Availability: AD-A057 219/857  
NTIS

Contents: Collective Accelerators; Microwaves and Unneutralized  
E-Beams; Technology; and Laser Applications.

Primary Keywords: Electron Beams; Ion Beams; Electron Accelerators;  
Ion Accelerators; Relativity Theory; Masses;  
Transport Properties; Laser Pumping; Symposia

Secondary Keywords: Reflex Triodes; Meetings; NTISDDXA

8383  
(INSULATION, MATERIAL)  
(Liquid)  
WATER AS DIELECTRIC IN HIGH-VOLTAGE IMPULSE DEVICES

V.Y. Ushakov  
(10/1976).  
Availability: UCRL-Trans-11185  
NTIS

In exploding-wire and ultrafast plasma-heating experiments, for  
the production of high-power x-ray flashes and fast-electron pulses,  
and in a number of other situations, generators of large impulse  
currents (10 exp 6 A) and voltages (10 exp 6 to 10 exp 7 V) with  
nanosecond fronts are needed. The results available in the literature  
and the author's data on the principal aspects of the use of water as  
a dielectric in high-voltage impulse storage and switching devices  
are summarized. (ERA citation 02:023161)

Primary Keywords: High-voltage Pulse Generators; Water; Dielectric  
Properties; Electrical Insulation; Energy Storage;  
Switches

Secondary Keywords: ERDA/420800; ERDA/360603; Translations: USSR;  
Dielectrics; NTISERDA

Distribution Restriction: TRANSLATED FROM PP 96-113 OF POWERFUL  
NANOSECOND IMPULSE SOURCES OF ACCELERATED  
PARTICLES. IZDANIYE SVVO "NAUKA",  
NOVOSIBIRSK, 1974.

8390  
A SIMPLE GENERATOR OF SEVERAL-HUNDRED-KILOVOLT PULSES WITH NANOSECOND  
RISE TIMES

J.C. Blackburn and R.D. Genuario  
Harry Diamond Labs, Washington, DC 20438  
No. HDL-TM-73-24, 21p (11/1973).  
Availability: AD-780 927/9  
NTIS

A system for producing rectangular 0.5 MV pulses with rise times  
of about 1 nsec and duration between 5 and 20 nsec is described. A  
coaxial line is pulse-charged from a Marx-type autotransformer and  
then discharged by a fast-rise high pressure switch into a matched  
CuSO<sub>4</sub> load resistor. A low-inductance capacitive voltage divider  
allows monitoring of the pulse. The jitter and delay in the discharge  
switch total less than a microsecond, allowing synchronization with  
other events. The system has been in use for 1-1/2 years with  
satisfactory results. (Author)

Primary Keywords: Pulse Generators; Short Pulses; Nondestructive  
Testing; Ceramic Materials

Secondary Keywords: NTISA

8399  
ANTARES PROTOTYPE 300-KJ, 250-KA MARX GENERATOR (FINAL REPORT)

K.B. Riene, L.L. Parrone, K.J. Bickford and G.H. Livermore  
Los Alamos National Labs, Los Alamos, NM 87545  
(01/1981).  
Availability: LA-8491  
NTIS

A high-energy, low-inductance, low prefire rate, low trigger  
jitter, high-voltage, pulsed-power supply was needed to drive the gas  
discharge in the Antares laser power amplifier. This report describes  
the design and testing of a Marx generator that meets these  
requirements, the development and testing of a high-capacity spark  
gap, and the selection of suitable capacitors and resistors. (EPA  
citation 05 010021)

Primary Keywords: Antares Facility; Carbon Dioxide Lasers; Power  
Supplies; Capacitors; Design; Performance Testing;  
Resistors; Spark Gaps

Secondary Keywords: ERDA 700208, ERDA/420300; NTISDE

8403  
(ENERGY STORAGE, CAPACITIVE: PULSE GENERATORS)  
(Marx Generators; Marx)  
COAXIAL MARX GENERATOR FOR PRODUCING INTENSE RELATIVISTIC ELECTRON BEAMS  
Y. Kubota, S. Kawahara, A. Miyahara and H. Sead  
Nagoya University, Nagoya, Japan  
Japanese Journal Of Applied Phys cs, Vol. 13, No. 2, pp 260-263  
(12/1974).

The construction and operation of a coaxial Marx generator is  
described in this paper. An output voltage of 600 kV, 80 nH  
inductance, and stored energy of 160 J make this Marx generator a  
good candidate for a beam generation with a diameter of 25 cm and  
length of 100 cm. The device is also very compact. 6 Refs.

Primary Keywords: Marx Generators; Coaxial Configuration; 80 nH  
Inductance; 600 kV Output Voltage; 160 J Stored  
Energy

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PHYSICS

8407  
(REVIEWS AND CONFERENCES: ENERGY STORAGE, CAPACITIVE)  
(Reviews: Reviews)

CRITICAL PULSE POWER COMPONENTS

W.J. Sargeant (1) and G.J. Rohwein (2)  
(1) Los Alamos National Labs, Los Alamos, NM 87545  
(2) Sandia Labs, Albuquerque, NM 87115  
Los Alamos Report No. LA-UR-81-1249  
Availability: LA-UR-81-1249  
NTIS

Critical components for pulsed power conditioning systems will be  
reviewed. Particular emphasis will be placed on those components  
requiring significant development efforts. Capacitors, for example,  
are one of the weakest elements in high-power pulsed systems,  
especially when operation at high-repetition frequencies for extended  
periods of time are necessary. Switches are by far the weakest active  
components of pulse power systems. In particular, opening switches  
are essentially nonexistent for most applications. Insulation in all  
systems and components requires development and improvement. Efforts  
under way in technology base development of pulse power components  
will be discussed. 37 Refs.

Primary Keywords: Pulsed Power Conditioning Systems; Long Life  
Energy-transfer System Components; High Energy  
Density Capacitors; Capacitor Development

8414  
DEVICE FOR GENERATING POWERFUL ELECTRICAL PULSES  
B.I. Kulikov, V.M. Lagunov, Y.Y. Nesterikhin and V.M. Fedorov  
FID, Wright-Patterson AFB, OH  
No. FID-ID(RS)T-2129-78, 8p (12/1978).  
Availability: AD-A066 677/657  
NTIS

No abstract available.

Primary Keywords: Pulse Generators; Translations: USSR

Secondary Keywords: Patents; NTISDDXA; NTISFNR

8594  
ACTIVE LAMP PULSE DRIVER CIRCUIT

K.E. Logan  
Goddard Space Flight Center, Greenbelt, MD  
Patent Application No. PAT-APPL-6-276 748, 24p (12/1978).  
Availability: N2-10390/4  
NTIS

A flashlamp drive circuit is described in detail. The device uses  
an unsaturated transistor as a current mode switch to periodically  
subject a partially ionized gaseous laser excitation flash-lamp to a  
stable, rectangular pulse of current from an incomplete discharge of  
an energy storage capacitor. A monostable multivibrator sets the  
pulse interval, initiating the pulse in response to a flash command  
by providing a reference voltage to a non-inverting terminal of a  
base drive amplifiers. A tap on an emitter resistor provides a  
feedback signal sensitive to the current amplitude to an inventory  
terminal of the amplifier, thereby controlling the pulse amplitude.  
The circuit drives the flashlamp to provide a square-wave current  
flashlamp discharge.

Primary Keywords: Patent Applications; Flash Lamps; Optical Pumping;  
Pulse Generators; Pulsed Lasers; Switching Circuits;  
Current Regulators; Feedback Circuits; Ionization;  
Laser Pumping; Optical Resonators; Pulse Amplitude;  
Square Waves; Transistor Circuits

Secondary Keywords: NTISGPNASA

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AVAILABLE NTIS.

8595  
AN ELECTROMECHANICAL PULSE SOURCE

S.A. Stopylov, A.V. Loos, Y.G. Romanov and V.F. Sergeev  
FID, Wright-Patterson AFB, OH  
No. FID-ID(RS)T-0662-81, 6p (08/1981).  
Availability: AD-A103 779/5  
NTIS

No abstract available.

Primary Keywords: Pulse Generators; Alternators; Short Circuits;  
Electric Coils; Stators; Rotors; Translations: USSR

Secondary Keywords: Electromechanical Sources; Synchronous Generators;  
NTISDDXA; NTISFNR

8601  
AN X-RAY DIAGNOSTIC FOR LIGHT-ION CURRENT MEASUREMENTS

P.D. Bleach, D.J. Nagel, D. Mosher and S.J. Stephanakis  
Naval Research Lab, Washington, DC 20375  
Memorandum rept. No. NRL-MR-4462, 29p (03/1981).  
Availability: AD-A095 923/9  
NTIS

A technique to determine the number and current density of MeV  
protons in an intense beam was tested on the GAMBLE II generator.  
Diode current and voltage and an absolute measurement of K-line  
radiation emitted from a 6 micronmeter thick aluminum target were used  
to determine the number and current density of protons incident on  
the target. Time-dependent x-ray measurements can be used to infer  
variations in the ion-beam current density.

Primary Keywords: Proton Beams; X Ray Diagnostics; Current Density;  
Spectrum Analysis; Pulse Generators; Metal Films;  
Targets; Aluminum; Emission Spectra

Secondary Keywords: GAMBLE 2 Pulse Generators; NTISDDXA

8602

## ARC DISCHARGE SOURCES

C.M. Church and R.G. Schlecht  
Westinghouse Research and Development Center, Pittsburgh PA  
Semiannual technical summary report, no. 1, 16 Oct 64-15 Apr 65 No.  
65-9C1-148-R3, 129p (05/1965).  
Availability: AD-652 792/357

NTIS

A simple theoretical model for the high energy pulsed arc discharge has been proposed, in which thermal conduction and radiative transfer occur within the arc. Radiative transfer is discussed both in general and as applied to the model. The theoretical evaluation of the various physical properties of the arc plasma, that are required in finding a solution to the model, including absorptivity, thermal and electrical conductivities are described using simple and relatively complete expressions. Calculations which consider the arc to be of homogeneous temperature of the form of a plane parallel slab and a cylinder are described, with results indicated for the plane parallel slab using a simplified representation of the electron density and absorptivity. Experimental measurements necessary to validate the model are discussed. Measurements of the spectral radiance in the ultraviolet at different radial points are presented. (Author)

Primary Keywords: Electric Arcs; Lasers; Mathematical Models; Electric Discharges; Electron Density; Programming (Computers); Ultraviolet Radiation; Measurement; Thermal Conductivity; Electrical Conductivity; Argon; Krypton; Xenon; Transport Properties; Emissivity

Secondary Keywords: Defense Project; Electric Discharge Lasers; Laser Pumping; NTISDODX

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8603

## BLUMLEIN LINE GENERATION OF LONG-PULSE, PRECISELY REGULATED WAVESHAPES FOR NONLINEAR RESISTIVE LOADS

M.A. Reass  
Los Alamos National Labs, Los Alamos, NM 87545  
No. LA-UR-81-1670, 4p (01/1981).  
Availability: DE81025380

NTIS

This paper describes the criteria utilized in the design of a long-pulse, offset-tuned Blumlein generator. It is designed to have a medium repetition rate (100-200 Hz) pulses for nonlinear loads (such as klystrons), with a total power deviation of less than 0.5% (ripple, overshoot, and droop, inclusive). (ERA citation 06:027550)

Primary Keywords: High-voltage Pulse Generators; Experimental Data; Klystrons; Pulse Shapers; Pulses; Tuning

Secondary Keywords: ERDA/420800; NTISDE

8604

## CALCULATIONS FOR EXPLOSIVE MAGNETIC GENERATORS

S.G. Hibben  
Informatics, Inc., Rockville, MD  
Interim report, (10/1976).  
Availability: AD-A107 746/0

NTIS

This is a translation of a Soviet paper which develops generalized criteria for optimum design of an explosive magnetic generator. Studies on techniques for pulsed compression of magnetic fields, with the resultant high pulse power generation, were actively pursued in the late 1960s and the early 1970s both here and abroad. In recent years the interest in these techniques appears to have dwindled, notably in the U.S. A recent search by the Smithsonian Science Information Exchange, in fact indicates no current U.S. research program under way on explosive compression of magnetic fields. In contrast, a continuing study of explosive cumulation is being maintained in the USSR, in particular under the direction of Bichenkov and Lobanov at Novosibirsk. These authors have published a series of papers on theoretical and experimental aspects of explosive compression, in which both coaxial and planar semicircular geometries have been investigated.

Primary Keywords: Explosive Decompression; Pulse Compression; Pulse Generators; Magnetic Fields; Explosive Charges

Secondary Keywords: Explosive Magnetic Generators; Magnetic Flux; Magnetic Field Compression; NTISDODX

8607

## COLLECTIVE ION ACCELERATION AND ELECTRON BEAM PROPAGATION IN DIELECTRIC GUIDES

M.D. Halverson  
Spire Corp., Bedford, MA 01730  
Final report, 1 Feb 79-31 Jan 81 No. FR-10067, 59p (05/1981).  
Availability: AD-A102 874/5

NTIS

The propagation of electron beam currents much greater than the space charge limit and collective ion acceleration in evacuated dielectric guides was investigated. Experiments at Spire and at the Gamble I facility of NREL show that the beam front propagation velocity is not affected by the dielectric guide downstream from the anode region of the accelerator. The propagated current, however, depends strongly on guide parameters, and is considerably diminished in a shortened guide configuration. Collectively accelerated ions were not observed using the 40 ns, 200 keV electron accelerator at Spire, although earlier experiments using longer, lower energy pulses showed considerable ion acceleration. Proton energies more than 14 times the electron beam energy were observed during the experiment on Gamble I. An estimated 2x(10 to the 9th power) protons at 12 MeV or greater along with 3x(10 to the 11th power) protons at 5 MeV or greater were observed in a single shot. The origin of the collectively accelerated protons was principally in the anode foil of the accelerator. Suggestions for increasing the energy and yield of collectively accelerated ions include improving the homogeneity of the downstream plasma and reducing the magnetic field of the propagating electron beam current. (Author)

Primary Keywords: Ion Acceleration; Dielectric Waveguides; Limiting; Space Charge; Current Density; Vacuum; Electron Beams; Ion Beams; Plasma Diagnostics; Neutron Activation

Secondary Keywords: Gentle I Pulse Generator; NTISDODXA; NTISDODAF

8608

## COLLECTIVE ION ACCELERATION WITH INTENSE RELATIVISTIC ELECTRON BEAMS

R.B. Miller and D.C. Straw  
AFWL, Kirtland AFB, NM 87117  
Final report, No. AFWL-TR-75-236, 80p (04/1976).  
Availability: AD-7025 943/257

NTIS

Recent theoretical and experimental investigations of ion acceleration occurring when an intense relativistic electron beam is injected into low pressure neutral gases have yielded a fairly complete description of the process. In this report the experimental procedure and results of the collective ion acceleration program at the Air Force Weapons Laboratory, including related diode and beam propagation work, are examined in detail. Important conclusions pertaining to the existence of an ion acceleration threshold current, to accelerated ion energy spectra, and to process efficiency are reported. (Author)

Primary Keywords: Ion Accelerators; Electron Beams; Pulse Generators; Cations; Threshold Effects; Energy; Spectra; Streak Cameras; Space Charge; Electric Current; Ionization; Neutralization

Secondary Keywords: Relativistic Beams; Collective Acceleration; Beam Propagation; Neutral Gases; Drift Tubes; NTISDODXA; NTISDODXF

8617

## DIELECTRIC MATERIALS FOR STRUCTURAL APPLICATIONS AND HIGH-VOLTAGE INSULATION IN DEIONIZED WATER FOR PARTICLE-BEAM ACCELERATORS

J.P. Furaus  
Sandia Labs, Albuquerque, NM 87115  
No. SAND-81-1713C, 6p (01/1981).  
Availability: DE81027203

NTIS

The pulsed energy programs at Sandia National Laboratories (SNLA) have often required dielectric materials that provide a dual role of high voltage insulation as well as critical structural support. One typical application is the dielectric tension rods for the triatron gas switch used on the PBFA-I Accelerator. This paper describes the performance of dielectric materials used in the past and recent evaluations of alternative materials that have resulted in significant cost and performance improvements. (EPA citation 06:029174)

Primary Keywords: High-voltage Pulse Generators; Linear Accelerators; Electrical Insulators; Mechanical Structures; Performance; Pulse Techniques; Switches

Secondary Keywords: ERDA/430303; NTISDE

8618

## DIRECT CONTROL OF LARGE POWER SERIES TRIODES WITH TRANSISTORS FOR HIGH VOLTAGE POWER SOURCE

M. Fukuda and K. Matsura  
Nagoya University, Nagoya, Japan  
(02/1979)  
Availability: IPPJ-DT-62

NTIS

The control of high voltage, large power output is often required in high frequency power sources for plasma experiments. For this purpose, power transmitter tubes such as triodes or tetrodes have been used as the series control tubes. However, in case of large power, the driving power for the series control tubes also becomes large, and it leads to the requirement of large space and high cost. In order to solve such problem, the driving with transistor circuits has been experimented. Transistor circuits permit large current, but have comparatively low withstand voltage. However, the problem of withstand voltage has been solved by employing multi-stage series connection. First, the transistor circuit used has been analyzed, and the testing circuit was produced for trial and tested. The selected transistors were 2SD520 of Darlington connection as the main transistor, and 2SC995 or 2ET 25K95C as the prestage transistor. The power source of 72kV to 400 V has been prepared. In general, such a circuit tends to cause parasitic oscillation (of several MHz). To prevent this oscillation, capacitors of approximately 100 pF were connected in parallel with bleeder resistors. These capacitors did not affect the response speed of the system, since the transistor failures in such a system may cause load breakage, the circuit must be protected by employing current limiters such as fast blowing fuses and Zener diodes for the protection from surge voltage. In the practically applied

Primary Keywords: Therm Nuclear Devices; DC Amplifiers; Electronic Circuits; High-voltage Pulse Generators; Klystrons; Plasma; Power Conditioning Circuits; Power Supplies; RF Systems; Transistors

Secondary Keywords: IN JAPAN; SE: Foreign Technology; ERDA/700203;

Distribution Restriction: U.S. SALES ONLY.

8620

## ELECTRIC MACHINE SOURCE OF IMPULSES

G.A. Sipaylov and A.V. Loos  
FTD, Wright-Patterson AFB, OH  
No. FTD-IDP(517)-0663-81, 8p (07/1981).  
Availability: AD-A103 466/9

NTIS

No abstract available.  
Primary Keywords: Pulse Generators; Synchronization(Electronics); Magnetic Drives; Patents; Translations

Secondary Keywords: NTISDODXA; NTISFNUR

8627

## EXPERIMENTS IN MAGNETIC SWITCHING

D.L. Birx, E.J. Laufer, L.L. Reginato, D.J. Rogers and M.M. Smith  
Lawrence Livermore Lab, Livermore, CA 94550  
No. CONF-810659-6, 9p (05/1981).  
Availability: UCRL-85738

NTIS

Magnetic switching offers an alternative to overcoming the repetitive and life limitations of the spark gaps in the ELI/ATA induction accelerators. The principle has been applied for many years to radio modulators but at much lower power levels and longer pulse lengths. Concurrently recent developments in magnetic materials together with some optimal circuits have made it possible to go well beyond the state of the art. A magnetic modulator has been built which stores up and compresses a 25 kV, 5 nsec pulse into a 250 kV, 50 nsec pulse. A second magnetic modulator has been built and installed to replace four Blumleins and spark gaps in order to provide triggers for the complete EIA injector and accelerator. The paper outlines some practical and theoretical considerations affecting the design of the magnetic pulse generator. (ERA citation 06:024087)

Primary Keywords: Linear Accelerators; Switching Circuits; Key Range 100-1000; Kilo Amp Beam Currents; Magnetic Fields; Modulation; Performance; Pulse Generators; Trigger Circuits

Secondary Keywords: ERDA/430303; NTISDE

**8628**  
**EXPERIMENTS ON THE INTERACTION OF HIGHPOWER MICROWAVES WITH AIR**  
 W.M. Bollen, R.K. Parker and W.M. Black  
 Mission Research Corp., Alexandria, VA 22304  
 Final rept. 4 Apr 80-4 Jun 81 No. MRC/MDC-R-015, 37p (07/1981).  
 Availability: AD-A106 370/8  
 NTIS

The physics of gas breakdown for large collision frequency,  $\nu_{\text{coll}} > 1$ , is being pursued at the Naval Research Laboratory. The hybrid inverted coaxial magnetron, 500MW, 3.2 GHz, 30ns pulse width, allows investigation of gas breakdown in the high  $\nu_{\text{coll}}$  regime. The 35 GHz gyrotron, 150KW, 300ps, allows investigation in a moderate  $\nu_{\text{coll}}$  regime. Large gas breakdown plasma densities have been measured, n approx.  $100 \text{ n sub c}$ . Spectral measurements have been made showing only excitation of molecular bands. Preliminary propagation experiments have also been performed. (Author)

Primary Keywords: Gas Breakdown; Plasma Generators; Air; Molecular Spectroscopy; Emission Spectra; Pulse Generators; Band Spectra; Radiofrequency Power; Molecular Structure; Ka Band; Langmuir Probes; S Band; Magnetrons; Physics

Secondary Keywords: Inverted Magnetrons; Coaxial Magnetrons; Circular Modes; Collision Frequencies; Gyrotrons; NTISDODXA

**A612**  
**FAST, VERSATILE POKKELS CELL DRIVER**  
 J.A. Dacles, DC Downs and D.J. Kuzenog  
 Lawrence Livermore Lab., Livermore, CA 94550  
 No. LLL-8-772, 6p (06/1981).  
 Availability: DE81024365  
 NTIS

Vacuum planar triodes, normally used in S-Band radar applications, can also serve as excellent switch tubes in fast, low jitter pulse generators. Laser systems have need of such generators for driving Farwick coils. Development work in this area has resulted in three successive driver designs. The present two-chassis unit will serve as a standard driver in the Nova and Novette laser systems. This assembly is capable of driving nine kilovolts into 75 ohms with three nanoseconds risetime and less than 100 picoseconds short term jitter. Rise and fall times of approximately two nanoseconds are available at half output voltage swing. (ERA citation 06:032764)

Primary Keywords: Lasers; Nova Facility; Pokkels Cell; Pulse Generators; Design; Performance; Pulse Rise Time; Pulse Shapers; Switches; Switching Circuits; Triode Tubes

Secondary Keywords: ERDA/700208; ERDA/420300; NTISDE

**8633**  
**FIBER OPTIC TELEMETRY SYSTEM FOR LLL HIGH-VOLTAGE TEST STAND**  
 J.P. Richter  
 Lawrence Livermore Lab., Livermore, CA 94550  
 No. LLL-77-1029-79, 6p (10/1977).  
 Availability: UCRL-79588  
 NTIS

This paper describes the Fiber Optic Telemetry System designed to operate in the hostile particle and electromagnetic radiation environment of the High Voltage Test Stand. It discusses system criteria, components, packaging, and performance. In all tests to date, the system exceeds its design goals with very comfortable margins. It is well advanced into the fabrication stages with all crucial components tested and only straightforward TTL (Transistor Transistor Logic) circuitry to be completed. (ERA citation 03:020715)

Primary Keywords: Data Transmission; Neutral Beam Sources; Optical Equipment; Design; Telemetry; Test Facilities

Secondary Keywords: ERDA/700205; Fiber Optics Transmission Lines; Telemetering Equipment; High Voltage Test Stand; NTISDE

**8649**  
**HIGH VOLTAGE PULSE GENERATOR FOR INFLECTOR**  
 S. Asakawa, M. Mutoh and T. Yamakawa  
 Tokyo Univ. (Japan), Inst. for Nuclear Study.  
 (05/1979).  
 Availability: INS-TH-121  
 NTIS

Recently, an injector linac for INS 1.3 GeV electron synchrotron was reconstructed and the output beam energy of the linac was increased from 9 MeV to 13 MeV. Therefore, in order to increase the injector voltage a new power supply has been reconstructed. The new power supply consists of a line type pulser and a pulse transformer with step up ratio 1:12, and generates the pulse of 96 KV height, 6  $\mu\text{sec}$  width with repetition rate of 20 Hz. It has been operating very well. (Atomindex citation 11:538354)

Primary Keywords: Tokyo Synchrotron; High Voltage Pulse Generators; H-Range; Linear Accelerators; Performance; Power Supplies; Specifications; Transformers

Secondary Keywords: IN JAPANESE; Foreign Technology; ERDA/430300; NTISINIS; NTISFNJA

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**8651**  
**HIGH VOLTAGE, MAGNETICALLY SWITCHED PULSED POWER SYSTEMS**  
 J.P. VanDevender and R.A. Reber  
 Sandia Labs., Albuquerque, NM 87115  
 No. SAND-81-0756C, 12p (01/1981).  
 Availability: DE81026290  
 NTIS

The principles of magnetic switching are briefly described. Then the results of experiments on the following substantive topics for magnetic switching are presented: material properties and how they relate to switch performance; rise-time limitations; and core insulation. Magnetic switching is then evaluated from a system perspective. An idealized pulse power system with 200 kJ or stored energy and a 40 ns output pulse is examined. The multi-megavolt electrical insulation requirements impose limitations on the switches. The cost of the magnetically switched system exceeds the cost of the conventional super-power generator system by up to 75%. The potential for reliability, reproducibility, and repetitive pulse capability must be evaluated for each application to offset the increased cost. (ERA citation 06:014652)

Primary Keywords: High Voltage Pulse Generators; Design; Performance; Pulse Technology; Reliability; Switching Circuits

Secondary Keywords: ERDA/420300; ERDA/420300; NTISDE

**8653**  
**HIGH-VOLTAGE AIR-CORE PULSE TRANSFORMERS**  
 G.J. Rohwein  
 Sandia Labs., Albuquerque, NM 87115  
 No. SAND-80-0451, 3p (08/1981).  
 Availability: DE81030399  
 NTIS

High voltage air core pulse transformers are best suited to applications outside the normal ranges of conventional magnetic core transformers. In general these include charge transfer at high power levels and fast pulse generation with comparatively low energy. When properly designed and constructed, they are capable of delivering high energy transfer efficiency and have demonstrated superior high voltage endurance. The general types designed for high voltage pulse generation and energy transfer applications are described. Special emphasis is given to pulse charging systems which operate up to the multi-megavolt range. (ERA citation 06:033657)

Primary Keywords: High-voltage Pulse Generators; Transformers; Design; Eddy Currents; Electrical Insulation; Electronic Circuits; Equivalent Circuits; Operation; Trigger Circuits; Uses

Secondary Keywords: ERDA/420300; NTISDE

**8659**  
**LOW FREQUENCY PULSE GENERATOR APPARATUS**  
 D.C. Le Pierre  
 Department of the Air Force, Washington, DC  
 Patent Application No. PAT-APPL-6-227 537, 13p (08/1981).  
 Availability: AD-D008 749/4  
 NTIS

The present invention utilizes one of a plurality of variable capacitors which may be switched into an R-C timing network to establish the pulse repetition rate of the pulse generating circuit. The output of the pulse generator unit is amplified and applied to a predetermined counter unit wherein, upon accumulation of the desired count, an interrupt signal is generated. The interrupt signal which is applied to the pulse generator unit disables the pulse output and thereby allows the generation of a predetermined number of pulses. It is one object of the present invention, therefore, to provide an improved low frequency pulse generator apparatus. It is another object of the invention to provide an improved low frequency pulse generator apparatus wherein the pulse sequence is terminated upon reaching a predetermined pulse count. It is another object of the invention to provide an improved low frequency pulse generator apparatus to provide preset total number of output pulses at a selected pulse rate. It is yet another object of the invention to provide an improved low frequency pulse generator apparatus wherein the preselected pulse counting sequence will resume uninterrupted after an interrupt in the counting sequence.

Primary Keywords: Patent Applications; Pulse Generators; Variable Capacitors; Pulse Counters; Counting Methods; Low Frequency; Pulse Rate; Output; Counters; Pulses; Circuits; Sequences; Inventions; Accumulation

Secondary Keywords: RC Networks; Timing Networks; NTISGFI

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**8561**  
**LOW NOISE, LARGE DYNAMIC RANGE PULSE AMPLIFIER**  
 J. Colas and J.C. Lacotte  
 Grenoble-1 University, Grenoble, France  
 (03/1980).  
 Availability: LAPP-80-02  
 NTIS

We have developed a low noise, high dynamic range low cost amplifier. This amplifier will equip the shower position detector (current division output) and the photomultiplier of the forward electromagnetic calorimeter in the UA1 experiment (CERN anti pp collider). (Atomindex citation 11:566133)

Primary Keywords: Pulse Amplifiers; Shower Counters; Calorimeters; Design; Photomultipliers; Proton-antiproton Interactions

Secondary Keywords: Foreign Technology; ERDA/440104; NTISINIS; NTISFNFR

Distribution Restriction: U.S. SALES ONLY.

**8664**  
**MPD INTENSE BEAM PULSER**  
 P.J. Turchi and I.M. Virkivitsky  
 Department of the Navy, Washington, DC  
 Patent Application No. PAT-APPL-6-285 690, 36p (03/1980).  
 Availability: AD-D008 730/4  
 NTIS

An MPD intense beam pulser for generating high voltage, intense charged particle beams utilizing an electromechanical energy source and inductive energy storage in combination with a plasma opening switch including a source of directed plasma flow, a diode for accelerating particles in the plasma flowing from the source, and a plasma flow truncation circuit. In operation, a controlled plasma flow is used to conduct current from the energy source in order to supply a desired amount of energy to the magnetic field in the volume surrounding the plasma flow. Truncation of the plasma flow between the electrodes forming the diode then provides a high voltage in a short pulse which generates a high energy charged particle beam. Thus, the magnetic energy store surrounding the diode plasma flow is coupled directly to the intense particle beam. (Author)

Primary Keywords: Patent Applications; Plasma Generators; Particle Beams; Magnetic Fields; Electromechanical Devices; High Voltage; Plasmas(Physics); Charged Particles; Beams(Radiation); Plasma Control; Opening(Process); Diodes; Switches; Sources

Secondary Keywords: NTISGPN

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8674

## PARTIAL DISCHARGE TESTING OF BULK TRANSFORMER OIL

G.J. Rohwein  
Sandia Labs, Albuquerque, NM 87115  
No. SAND-81-0551C, 4p (01/1981).  
Availability: DE81023683  
NTIS

The generation of partial discharges in bulk transformer oil has been investigated experimentally to determine the dominant conditions which contribute to their formation and growth under repetitive impulse stresses. The motivation for conducting these experiments arose from a problem with partial discharges and breakdowns occurring in the insulating oil around the high voltage switch in a continuous running 1.5 MV repetitive pulsed system. From the experiment it was found that repetitive stressing caused low level field ionization around the electrodes which led to bubble formation and eventually partial discharges. There were also qualitative indications of charge accumulation in the oil. Photographic records of numerous shot sequences were used to study the phenomena. (ERA citation 06:023459)

Primary Keywords: Insulating Oil; Transformers; Breakdown; Dielectric Properties; Electric Discharges; Experimental Data; Pulse Generators

Secondary Keywords: ERDA/200300; NTISDE

Distribution Restriction: MICROFICHE ONLY AFTER ORIGINAL COPIES ARE EXHAUSTED.

8675

## PERFORMANCES OF THE OUTLET PULSE VALVE FOR THE PROTON SOURCE OF THE I-2 LINEAR ACCELERATOR

V.A. Batalin, A.A. Kolomiets and B.K. Kondrat'ev  
GKAE Atomic Energy Institute, Moscow, USSR  
(01/1979)

Availability: ITF-97(1979)  
NTIS

Described are the design, operating characteristics and work peculiarities of a pulse valve, fixed on the outlet of ion dioplasmatron source of the I-2 linear accelerator for the reduction of gas flow rate. The average gas flow rate constitutes 10 cm exp 1 /h. beam current on the outlet of the injector is 1.2 A. duration of the current pulse is 30  $\mu$ s. repetition frequency - up to 2 pulses a second. Given are an equation, describing gas regime of the ion source and its solution for the regime with pulse gas injection in the source and the regime with pulse gas extraction from the source. Considered are the curves of gas pressure change in a discharge chamber depending on time for both regimes. Evaluations, made on the example of the ion source of the I-2 linear accelerator show that the use of the pulse valve on the outlet permits to essentially decrease average gas flow rate as well as to avoid shortcomings, connected with operation at large volume of the discharge chamber and essential duration of the beam current pulse. (Atomindex citation 11:55263)

Primary Keywords: Proton Sources; Flowmeters; Gas Flow; High Vacuum; Linear Accelerators; Operation; Pulse Generators; Pulse Techniques; Pulses; Specifications; Valves

Secondary Keywords: IN RUSSIAN; Foreign Technology; ERDA/430301; NTISINIS; NTISFNUH

Distribution Restriction: U.S. SALES ONLY.

8677

## POWER FLOW FOR VACUUM-INSULATED INDUCTIVE LOADS

J.P. Vandevender  
Sandia Labs, Albuquerque, NM 87115  
No. SAND-81-0753C, 3p (01/1981).  
Availability: DE81023691  
NTIS

The transport of power through a vacuum insulator without flashover and through a short, self-magnetically insulated transmission line without gap shorting severely constrains the stored energy of the inductive load for 30 ns to 300 ns drive times. An electrostatic gap closure mechanism is presented and evaluated. The gap closure constraints are then combined with constraints imposed by magnetic insulation of the electrode from the cathode and by the vacuum insulator flashover to examine the vacuum power flow from a systems point of view. It is concluded that multimegapule drivers will be multi-megawatt sources. (ERA citation 06:027997)

Primary Keywords: Inertial Confinement; Pulse Generators; Electrodes; Performance; Power Supplies; Spark Gap

Secondary Keywords: ERDA/700208; ERDA/700211; NTISDE

8680

## PRIME POWER TO PULSE CONDITIONING INTERFACE METHODS

J.R. Silva  
AFIT, Wright-Patterson AFB, OH  
Master's thesis No. AFIT/GE/EE/80D-29, 77p (12/1980).  
Availability: AD-7100 527/5  
NTIS

AC and DC resonant charging hardware tests were conducted with a 15KW DOD standard 400 HZ generator as prime power. DC resonant charging caused vibrations of the generator at the pulsing frequency and instability of the voltage regulator due to the very irregular generator voltage waveform. The input DC voltage to the pulser sagged causing the performance to be lower than expected. An analysis of this problem and the theory to account for this sag is presented. Problems with the triggering of AC resonant charging were not solved in time for this report. The experimental set up of AC resonant charging is presented. AC resonant charging caused no negative impact on the generator which is a great advantage over DC resonant charging. (Author)

Primary Keywords: Electric Generators; Pulse Generators; Direct Current; Ultra-low Frequency; Alternating Current; Input; Impacts; Waveforms; Voltage; Power; Theories

Secondary Keywords: Resonant Charging; Pulse Conditioning; NTISDODAA

8683

## PRODUCTION AND FOCUSING OF A HIGH-POWER RELATIVISTIC ANNULAR ELECTRON

M.U.M. Friedman  
Cornell University, Ithaca, NY 14850  
No. IFS-36, 14p (01/1970).  
Availability: AD-706 040  
NTIS

A new electron beam injection gun has been developed to produce pulsed relativistic electron beams with a power of 10 to the 10th watts. The annual - seeded beam propagates in a magnetic field with efficiencies approaching 10% and its radius may be controlled by the magnetic field configuration. Typical results obtained with a 4-inch diameter cathode are reported. (Author)

Primary Keywords: Plasma Physics; Electron Beams; Electron Beams; Focusing; Electron Guns; Diodes

8689

## PULSED POWER FOR ELECTROMAGNETIC LAUNCHING

M. Cowan  
Sandia Labs, Albuquerque, NM 87115  
(12/1980)  
Availability: SAND-80-1987  
NTIS

There are system advantages to producing power for electromagnetic propulsion by real-time generation rather than by a sequence of generation-storage-switching. The best type of generator for this purpose is the flux compression generator. Different types of flux compression generator which have been developed at Sandia National Laboratories are reviewed and their applications to electric launching are discussed. New experimental facilities for producing more powerful generators are described and cost comparisons are made. (ERA citation 06:022426)

Primary Keywords: Pulse Generators; Railgun Accelerators; Cost; Design; Magnetic Compression; Power Demand; Propulsion; Pulsar Concept; Research Programs; Superconducting Magnets

Secondary Keywords: ERDA/420201; ERDA/700208; NTISDE

8691

## PULSED POWER RESEARCH COLLOQUIUM

M. Kristiansen  
Texas Tech University, Lubbock, TX 79409  
Annual rept. 1 Mar-28 Feb 81 (07/1981).  
Availability: AD-A105 770/2  
NTIS

A Pulsed Power Lecture Series is being conducted by Texas Tech University for the U.S. Air Force. Modular instructional material for use in this lecture series is being developed. Each module is a self-consistent discussion of some aspect of pulsed power technology. The contents range from the very basic (e.g. basic EM field theory) to advanced, modern topics, such as magnetic switching. The lectures are delivered every two weeks at the Air Force Institute of Technology and the Air Force Weapons Laboratory. The speakers then provide a written text of their lecture, which is edited and published in modular form by Texas Tech University. It is planned to reissue these modules in report or book form at a later date. A total of about 50 modules are planned. Some 30 lecturers have been presented to date, and about 12 modules have been issued. (Author)

Primary Keywords: Power Supplies; Pulse Generators; Bibliographies; Lectures; Research Management; Symposia; Technology; Forecasting

Secondary Keywords: NTISDODXA; NTISDODAF

8697

## STRIPLINE MAGNETIC MODULATORS FOR LASERS AND ACCELERATORS

M.C. Munally  
Los Alamos National Labs, Los Alamos, NM 87545  
No. LA-UR-81-1553, 5p (01/1981).  
Availability: DE81025258  
NTIS

The basics of magnetic modulators including magnetic element and circuit considerations as applied to accelerators and lasers requiring repetitive (1 to 10 kHz), high voltage (50 to 500 kV), short pulse (50 to 100 ns) are discussed. The scaling of energy losses and switching parameters with material are included. (ERA citation 06:027548)

Primary Keywords: High-voltage Pulse Generators; Accelerators; Design; Lasers; Magnets

Secondary Keywords: ERDA/420800; NTISDE

8699

## SUB-NAHOSECOND JITTER, REPETITIVE IMPULSE GENERATORS FOR HIGH RELIABILITY APPLICATIONS

G.J. Krauss and W.J. Sargeant  
Los Alamos National Labs, Los Alamos, NM 87545  
No. CONF-810859-3, 7p (01/1981).  
Availability: LA-UR-81-1655  
NTIS

Low jitter, high reliability impulse generator development has recently become of ever increasing importance for developing nuclear physics and weapons applications. The research and development of very low jitter (< 30 ps), multikilovolt generators for high reliability, minimum maintenance trigger applications utilizing a new class of high-pressure tetrode thyristors now commercially available are described. The overall system design philosophy is described followed by a detailed analysis of the subsystem component elements. A multi-variable experimental analysis of this new tetrode thyristor was undertaken, in a low-inductance configuration, as a function of externally available parameters. For specific thyristor trigger conditions, rise times of 18 ns into 6.0- ohm loads were achieved at jitter as low as 24 ps. Using this database, an integrated trigger generator system with solid-state front-end is described in some detail. The generator was developed to serve as the Master Trigger Generator for a large neutrino detector installation at the Los Alamos Meson Physics Facility. (ERA citation 06:024100)

Primary Keywords: Flash Tubes; High-voltage Pulse Generators; Capacitive Energy Storage Equipment; Capacitors; Design; Electronic Circuits; Neutrino Detection; Pulse Generators; Pulse Rise Time; Thyristors; Trigger Circuits

Secondary Keywords: ERDA/440104; ERDA/420800; NTISDE

8707

## TEST STAND FOR MAGNETRON H NEGATIVE ION SOURCE AT IPP-MAGOYA

M. Okumura, T. Kuroda and A. Miyahara  
Nagoya University, Nagoya, Japan  
No. IPPJ-1-33, 22p (02/1981).  
Availability: N81-25811/3  
NTIS

Test facilities for the development of magnetron H(-) ion source consists of the vacuum system, power supplies, diagnostic equipment, and their controlling electronics. Schematics are presented and relevant items described including sequence control, optical links, the charged pulse forming network, the extractor power supply, magnet power supply, temperature control of the cesium feeder, and the pulsed valve driver. Noise problems and diagnostics are also considered.

Primary Keywords: Ion Sources; Magnetrons; Negative Ions; Test Facilities; High Voltages; Optical Waveguides; Pulse Generators; Temperature Control; Vacuum Chambers

Secondary Keywords: Foreign Technology; NTISNASE; NTISFNJA

8716

## THYRATRON MARX HIGH VOLTAGE GENERATOR

T.F.J. Ewanizky  
Department of the Army, Washington, DC  
Patent Application No. PAT-APPL-6-224 684, 16p (12/1981).  
Availability: AD-DC08 183/6  
NTIS

This invention relates to a high voltage pulse generator of the Marx type, in which capacitors are charged in parallel and discharged in series. Amongst the many techniques for producing high voltage pulses, the Marx generator is probably the best known and most widely used. For the combination of short risetime and low output impedance (i.e. high power), large energy, high efficiency and waveform flexibility — the Marx principle is peerless. In response to the recognized need for a Marx generator capable of a high repetition rate, I have investigated Marx circuitry using modern thyristors as the switching elements. Because of the relatively high voltage trigger requirements of spark gaps, Marx circuitry developed for these devices has concentrated on achieving a balance between hold off reliability and triggering schemes that produce an orderly erection mode, so that predictable output pulses may be realized. High repetition rate capability, low voltage trigger requirements, and high reliability are well known thyristor characteristics when used in a conventional manner. However, particular problems arise with the use of thyristors in a Marx circuit, such as both external and internal arcing, because of progressively increasing overvoltages.

Primary Keywords: Patent Applications; Pulse Generators; Transformers; Winding; Thyristors; Switching; Secondary; Pulses; Inductors; Output

Secondary Keywords: MARK Generators; NTISGPA  
Distribution Restriction: AVAILABILITY: THIS GOVERNMENT-OWNED INVENTION AVAILABLE FOR U.S. LICENSING AND, POSSIBLY, FOR FOREIGN LICENSING. COPY OF APPLICATION AVAILABLE NTIS.

8726

## VARIABLE PULSE-WIDTH GENERATOR

L.E. BOLLINGER  
Ohio State University, Columbus, OH  
(11/1954)  
Availability: AD-051 660/9  
NTIS

No abstract available.  
Primary Keywords: Pulse Generators; Recording Systems; Rocket Engines; Timing Circuits; Design; Rockets; Tests  
Secondary Keywords: NTISD00XD; NTISD00XD  
Distribution Restriction: DISTRIBUTION LIMITATION NOW REMOVED. NOTE: ONLY 35MM MICROFILM IS AVAILABLE. NO MICROFICHE.

8730

## 4TH INTERNATIONAL TOPICAL CONFERENCE ON HIGH-POWER ELECTRON AND ION-BEAM RESEARCH AND TECHNOLOGY

J.R. Neighbours  
Office of Naval Research, London, UK  
Conference rept. No. ONR/C-6-81, 16p (12/1981).  
Availability: AD-A08 353/4  
NTIS

The Fourth International Topical Conference on High-Power Electron and Ion-Beam Research and Technology program included electron and ion beam generators, beam transport, plasma heating and free electron lasers. This report is principally about foreign research results. It also contains a list of speakers and the topics discussed.

Primary Keywords: Electron Accelerators; Ion Accelerators; Heating; Plasmas(Physical); Pumping(Electronic); Electrical Lasers; Relativity Theory; Electron Beams; Ion Beams; Free Electrons; High Power; Pulse Generators; Symposia; France

Secondary Keywords: Foreign Technology; Free Electron Lasers; Inertial Confinement Fusion; Marx Generators; Power Density; NTISD00XA; NTISFNUK; NTISFNUZ

8732

## A HALF MEGAWATT PULSE FORMING NETWORK (PFN)

J.E. Creedon and R.A. Fitch  
ECOM, Fort Monmouth, NJ 07703  
Research and development technical rept. No. ECOM-4494, 8p (04/1977).  
Availability: AD-A038 709/151  
NTIS

A lightweight half megawatt average power pulse forming network (PFN) designed to store 4 kilojoules (kJ) at 40 kilovolts has been developed. The energy storage system produces a 10 microsecond pulse at a repetition rate of 125 hertz and has a one ohm impedance. It is designed to operate adiabatically for durations of 60 seconds. A lifetime capability of over 400,000 pulses has been demonstrated. (Author)

Primary Keywords: Pulse Generators; Energy Storage; Capacitors; Full Modulation; Networks; Power

Secondary Keywords: NTISD00XA

8815

## (ELECTROMAGNETIC FIELD GENERATION: PARTICLE BEAMS)

(Electromagnetic Generation)  
IMPROVED DESIGN AURORA MODIFICATION PROGRAM (IDAMP)  
S.E. Graybill, A.G. Stamm, G.A. Nuttin, D.A. Kristaker and K.G. Harris  
Harry Diamond Labs, Adelphi, MD 20783  
MDL Report No. MDL-SR-81-8 (12/1981).  
Availability: MDL-SR-81-8

The AURORA High-Intensity Flash X-Ray Facility could be modified to provide a high-energy, medium (2 to 10 ohm) impedance, multi-megawatt pulse power source. This Improved Design AURORA Modification Program (IDAMP) could be achieved with only modest restructuring of the existing AMP water-insulated pulser, transformer oil, rather than doing away with the insulating medium. A power output of 5 MW in a pulse of 45 MV amplitude and approximately 140 ns FWHM is feasible in either positive or negative polarity. This power source could be applied to high-intensity electron, ion, and microwave beams. 0 Refs.

Primary Keywords: High-Intensity Electric Beam; High-Intensity Ion Beam; Source-Region Electromagnetic Pulse; AURORA; Single Line Marx Generator

Secondary Keywords: Microwave Source; Gamma Source

8815

## LARGE OUTPUT MILLIMICROSECOND IMPULSE GENERATOR USING ELECTROMAGNETIC SHOCK WAVES

J. Gravel, P. Gabco and F. Virsik  
FTD, Wright-Patterson AFB, OH  
No. FTD-ID(RS)-2207-75, 13p (12/1975).  
Availability: AD-A020 152/55T  
NTIS

No abstract available.  
Primary Keywords: Pulse Generators; Electromagnetic Wave Propagation; Shock Waves; Electric Discharges; Plasmas(Physics); Semiconductors; Magnetic Fields; Permeability(Magnetic); Nonlinear Systems; Czechoslovakia; Translations

Secondary Keywords: Seignette Electronics; NTISD00XA; NTISD00AF

8834

## OPERATION OF A 300 KV, 100 HZ, 30 KW AVERAGE POWER PULSER

M.T. Buttrich and G.J. Rohwein  
Sandia Labs, Albuquerque, NM 87115  
No. CONF-780676-1, 6p (01/1978).  
Availability: SAND-78-0933C

Applications for efficient and reliable pulse power systems with long lifetimes (>10 exp 8 shots) are foreseen for electron beam generators, heavy ion accelerators and lasers leading eventually to inertially confined fusion reactors. These systems will have to be capable of continuous operation for sustained periods without requiring major maintenance or repair. High operating efficiency will be required not only to minimize power consumption but also to avoid heat buildup and consequent damage to components. The system described in this paper represents an initial effort to develop an efficient energy handling high voltage pulser to study the problems of long life components. (ERA citation 04 002080.)

Primary Keywords: Linear Accelerators; Power Supplies; Design; Electric and Electron Beam Impact on; Electron Beam Targets; Electron Sources; Inertial Confinement; Lifetime; Pulse Generators; Thermonuclear Reactors; Transformers

Secondary Keywords: EPD47 00203; ERD4700208; High Voltage; NTISGE  
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8889

## (BREAKDOWN STUDIES)

(Vacuum, Electrical)

## A MODEL FOR DC INTERRUPTION IN DIFFUSE VACUUM ARCS

S.E. Childs and A.N. Greenwood  
Rensselaer Polytechnic Institute, Troy, NY 12181  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 4, pp 289-294 (12/1980).

A theoretical model for current interruption in a diffuse vacuum arc with DC commutation is described. Before current zero the interelectrode plasma is modeled as an ion-neutral fluid through which electrons are flowing. After current zero a positive ion sheath grows into the plasma from the former anode, driven by the transient recovery voltage. Using the basic laws of conservation, the decay of the plasma during commutation is evaluated numerically, enabling the post-arc current, the electric field at the former anode, and the power input to this electrode after current zero to be calculated. For copper electrodes, with a commutation time of 38 microseconds, the ion density and velocity at current zero are 23 percent and 15 percent of their respective steady state values. The calculated post-arc currents of tens of amps are in good agreement with experimental data. The post-arc data generated with this model can be used to study reignition mechanisms and the interrupting capability of different contact materials. 19 Refs.

Primary Keywords: Vacuum Arc; Diffuse Arc; Fluid Model; Ion Sheath; DC Current Interruption; Copper Electrodes; Theory

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8917

## (ENERGY CONVERSION: THERMAL)

(Magnetohydrodynamic)

## ACCURACY OF THE NET METHOD OF CALCULATING THE ELECTRICAL CHARACTERISTICS OF THE CHANNEL IN A MHD GENERATOR

A.A. Belyakov, V.I. Gusakov, V.I. Pishchikov and S.I. Pishchikov  
Academy of Sciences of the USSR, Moscow, USSR  
High Temperature, Vol. 19, No. 1, pp 123-127 (02/1981)  
Trans. Izv. Akad. Nauk SSSR, Vol. 19, No. 1, pp 158-163 (January-February 1981)

The integral electrical parameters of the channels in MHD generators have been calculated by means of electrical networks consisting of active and passive components. If there is substantial transverse inhomogeneity in the plasma parameters, the error in the calculation is determined by the number and dimensions of the net cells in the transverse direction. A simplified model has been used to estimate the error magnitude. The results are compared with calculations on channel No. 1 in the U-25B apparatus. 8 Refs.

Primary Keywords: MHD Generator; Circuit Modeling; Error Analysis; Theory; Comparison With Experiment

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8914

## (BREAKDOWN STUDIES)

(Vacuum, Electrical)

## AN INVESTIGATION OF THE TIME LAG OF THE DISCHARGE IN THE ELECTRICAL BREAKDOWN OF VACUUM GAPS

G.M. Reasirov and B.M. Koval'chuk  
Tomsk Polytechnic Institute, Tomsk, USSR  
Soviet Physics-Technical Physics, Vol. 9, No. 3, pp 377-379 (09/1964).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 34, 484-487 (March 1964)

The time lag of the discharge in the electrical breakdown of vacuum gaps of 0.1, 0.3, 0.5, and 1.0 mm with different degrees of overvoltage on the gap is investigated. It is shown that the time lag of the discharge in the breakdown of vacuum gaps decreases almost linearly with increase in the degree of overvoltage on the gap. With an equal and small degree of overvoltage on the vacuum gap, the time lag of the discharge varies nonlinearly with the interelectrode distance. In the region of interelectrode distances 0.3-0.5 mm there is a sharp increase in the time lag with increase in the interelectrode distance. 3 Refs.

Primary Keywords: Vacuum Breakdown; Formative Time Lag; 0.1-1.0 mm Gap; Delay vs Voltage Measurement; Dependence On Gap Spacing

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8916  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
ANODE SHEATH GROWTH AND COLLAPSE IN A HOLLOW-ANODE VACUUM ARC  
R. Dollinger, D.R. Dettman, J.L. Lee, A.S. Gilmour Jr., D.P. Malone and  
P.R. Schwartz  
State University of New York at Buffalo, Buffalo, NY 14226  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 4, pp 302-307  
(12/1980)  
Experimental diagnostics in a hollow-anode vacuum arc device have  
shown that the repetitive growth and collapse of an anode sheath is  
responsible for observed tens-of-kV voltage spikes. A dynamic model  
of device operation based on circuit effects and a time varying  
cathode-sheath length is presented. The scaling of the  
repetition rate with respect to cathode material is discussed. The  
device is being investigated for use as a current limiter for  
approximately 10 MW pulses. 12 Refs.  
Primary Keywords: Vacuum Breakdown; Hollow Anode; Anode Sheath  
Modulation; Voltage Spikes; Child-Langmuir Sheath;  
Theory; Comparison With Experiment  
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8917  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES; SWITCHES, OPENING)  
(Gas, Electrical; Gas; Recovery; Mechanical)  
ARC-GAS FLOW INTERACTIONS IN A DOUBLE-NOZZLE FLOW SYSTEM  
M. Tiemann  
Siemens Research Center, 8520 Erlangen, FRG  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 4, pp 368-375  
(12/1980)  
The physical phenomena in cold and arc heated double-nozzle gas  
flows have been investigated for 5F/sub 6/ by interference and shadow  
methods. The cold-flow phenomena are discussed as a basis for a  
better understanding of the arc-gas flow interactions, and their  
interference pattern is clearly interpreted: the observed fringes,  
which also can be calculated theoretically, are lines of constant  
flow velocity. In the case of arc heated flows a sharp distinction is  
made for the first time between different types of arc-gas flow  
interactions. At low peak currents the interference pattern still  
shows a cold gas flow around the arc. At higher current levels a  
fringe system, which indicates a density reduction, expands into the  
volume around the nozzle; however, the flow is still directed  
towards the gap between the nozzles. In contrast to this case the  
strongest form of interaction is characterized by the appearance of  
arc heated gas, which flows turbulently back into the high-pressure  
volume. The radial temperature distribution for a special arc has  
been calculated theoretically and is discussed in detail. 27 Refs.  
Primary Keywords: Circuit Interruption; Gas Blast; Circuit Breaker;  
Double-nozzle Configuration; Cold Flow; Arc-heated  
Flow; Holographic Interferometer Diagnostic;  
Shadowgraphy  
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8919  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
BEHAVIOR OF A HIGH CURRENT VACUUM ARC BETWEEN HOLLOW CYLINDRICAL  
ELECTRODES IN A RADIAL MAGNETIC FIELD  
R.L. Boxman, E. Gerby and S. Goldsmith  
Tel Aviv University, Tel Aviv, Israel 69978  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 4, pp 308-313  
(12/1980)  
Experimental observations were conducted on the behavior of a high  
current vacuum arc on cylindrical electrodes in a radial magnetic  
field. The arc was sustained between the ends of two cylindrical Cu  
electrodes, 56 mm diam and 1.5 mm wall thickness separated by 5 mm.  
Arc current pulses with peak values in the range 4-15 kA with a half  
amplitude full width (HAFW) duration of 8  $\mu$ s were investigated with  
rapid magnetic fields proportional to the instantaneous current with  
proportionality constants of 4.0 and 6.3E-6 T/A. The arcs were  
photographed simultaneously with a streak camera and by a high speed  
framing camera and the arc voltage was recorded on a digitizing  
transient recorder. The results indicated that the arc in this  
geometry, both with and without an imposed radial magnetic field, can  
be characterized by three development stages: a) arc formation; b)  
diffuse arc along the electrode perimeter; and c) simultaneous  
existence of several concentrated arc columns. When a radial magnetic  
field was imposed two changes were noted: 1) the arc appeared  
somewhat more distributed in that a greater number of concentrated  
columns were observed; and 2) they were distributed more evenly; and 2)  
the constricted columns, void in the  $\times$  B direction with velocities  
in the range 5-15 m/s. 7 Refs.  
Primary Keywords: Vacuum Breakdown; Cylindrical Geometry; Radial  
Magnetic Field; Copper Electrodes; Arc Development;  
Arc Movement; Photographs  
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8920  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
CALCULATION OF THE TEMPERATURE IN A CONDUCTIVE TRACK OF AN ARC ON THE  
SURFACE OF A MAGNET-BLAST CHUTE  
A. Tsiaf  
Ben Gurion University of The Negev, Beer-Sheva, Israel  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 4, pp 455-460  
(12/1980)  
The space and time temperature distribution is analyzed for a  
conductive track of a high current arc that was burned in the  
insulating channel of a magnet-blast chute. The thermal conditions in  
absence of boiling and ablation were considered by a combination of  
the methods of continuous and instantaneous energy sources, when the  
energy consumption for the phase transition is assumed to be uniform.  
The purpose of such analysis was a study of possibilities for using  
the additional energy absorption capacity of chutes by increasing the  
permissible temperature of their walls up to the boiling point. 10  
Refs.  
Primary Keywords: Magnet-blast Chute; Arc Quenching; Insulation Arc  
Tracks; Arc Re-ignition  
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8922  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES; SWITCHES, OPENING; BREAKDOWN  
STUDIES; BREAKDOWN STUDIES)  
(Vacuum, Electrical; Gas, Electrical; Mechanical; Gas; Recovery;  
Vacuum, Recovery)  
CURRENT CHOPPING INTRODUCED BY ARC COLLAPSE  
M.H.C. Van Den Heuvel  
Eindhoven University of Technology, Eindhoven, Netherlands  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 4, pp 326-331  
(12/1980)  
The intensive cooling by a moving gas can cause violent  
elongations and curls of the circuit breaker arc, especially when  
small currents are interrupted. During the elongation the arc voltage  
increases rapidly. This introduces a breakdown across a smaller  
distance by short circuiting a part of the arc. Here, such a  
breakdown is called arc collapse. The abrupt decrease in resistance  
and arc voltage may give rise to an oscillating discharge of the  
circuit breaker parallel capacitance into the arc path. This  
oscillation can force the main current to zero and thus cause current  
chopping. In this paper this kind of current chopping is studied and  
compared with chopping by instability oscillation. It is  
theoretically explained why these independent origins for chopping  
produce the same chopping levels. 17 Refs.  
Primary Keywords: Vacuum Breakdown; Gas Breakdown; Circuit Breaker;  
Current Chopping; Arc Motion; Theory  
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8924  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
DETERMINATION OF TEMPERATURE, VELOCITY DISTRIBUTION, AND POPULATION  
DENSITIES OF NEUTRAL HELIUM BY MEANS OF LASER LIGHT TUNED ON ATOMIC  
RESONANCES  
M. Odenthal and J. Uhlenbusch  
Universität Düsseldorf, Düsseldorf, FRG  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 4, pp 431-436  
(12/1980)  
Temperature, velocity distribution, and population density of  
neutral Helium in the 2<sup>nd</sup> sup 3/P level in a discharge of different  
current and pressure values are measured by absorption, dispersion,  
and resonant scattering experiments. The light source for these  
investigations is a tunable dye laser with line-width of 2 MHz. The  
measurements show that there is good mutual agreement among each of  
these methods and that these diagnostic methods are very easily  
adapted to investigate discharges with low densities of population,  
where Doppler-broadening mechanisms predominate. In addition, the  
experimental values of the index of refraction are compared with the  
linear dispersion theory confirming the predicted theoretical  
profiles. 7 Refs.  
Primary Keywords: Helium Breakdown; Neutral Helium Population; Several  
Diagnoses; Good Agreement  
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8925  
(BREAKDOWN STUDIES)  
(Gas, Microwave)  
DISTRIBUTION FUNCTION AND MEAN ENERGY OF ELECTRONS IN A HIGH-FREQUENCY  
MOLECULAR-GAS DISCHARGE  
A.V. Evseev and A.V. Eletskii  
I.V. Kurchatov Institute of Atomic Energy, Moscow, USSR  
High Temperature, Vol. 19, No. 1, pp 7-12 (02/1981).  
Trans. From: *Tekhnicheskaya Vysokikh Temperatur* 19, 8-15  
(January-February 1981)  
On the basis of solving the Boltzmann kinetic equation for  
electrons in a high-frequency discharge taking account of elastic  
and inelastic electron-molecule collisions, and also the diffusional  
drift of the electrons to the wall of the discharge tube, it is  
established that, from the viewpoint of electron energy balance in a  
discharge of the given type, two different operating modes may be  
distinguished. In the first, a considerable fraction of the energy  
expending in the discharge is consumed in exciting vibrational  
degrees of freedom of the molecules, while in the other, the basic  
mechanism of electron energy loss is associated with elastic  
electron-molecule collisions. The conditions for the discharge to  
pass from one mode to the other are obtained and the dependence of  
the mean electron energy on discharge parameters is calculated.  
4 Refs.  
Primary Keywords: High-Frequency Gas Breakdown; Boltzmann Equation;  
Electron-Molecule Collisions; Electron Diffusion; Two  
Discharge Modes; Theory  
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8927  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
EFFECT OF PLUG FLOW ON THE STABILITY OF TWO-DIMENSIONAL ARCS  
I.M. Chen, P.S. Ayvazyan and T. Sundaresan  
University of Pennsylvania, Philadelphia, PA 19104  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 4, pp 390-394  
(12/1980)  
Steady solutions to the governing equations that describe fully  
two-dimensional arc plasmas in a plug flow have been obtained. The  
stability of these steady solutions is investigated by calculating  
the transient created when infinitesimal changes in the electrode  
potentials are imposed. Comparisons are made with solutions obtained  
using a one-dimensional electric field. We find that with increasing  
blowing (Peclet number) the one-dimensional electric field solutions  
yield increasingly inaccurate results for higher currents. The  
stability results conform with those given by the classical Kaufmann  
criterion. We find that convection tends to reduce and eventually to  
eliminate the declining branch of the current-voltage characteristic.  
The presence of convection promotes axial temperature gradients in  
the arc and hastens the transition from the unstable (declining)  
branch to a stable (increasing) branch of the current-voltage  
characteristic. 9 Refs.  
Primary Keywords: Arc Stability; Plug Flow; 2-d Arc Model; Comparison  
With 1-d Model; Theory; Comparison With Experiment  
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8928  
(BREAKDOWN STUDIES)  
(Electrodes)  
EFFECT OF SELF-MAGNETIC FORCES ON THE ANODE MECHANISM OF A HIGH CURRENT DISCHARGE

M. Hugel  
Institut für Technische Physik, DFVLR, Stuttgart, FRG  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 4, pp 437-442  
(12/1980).  
When a DC discharge is operated between a central cathode and a ring-shaped anode at current up to 6E3 A and pressures on the order of a few Torr, the stable discharge regime is found to be limited. The anode fall voltage is determined experimentally from calorimetric and potential measurements. In a wide range of operating conditions its variation correlates well with the parameter  $J/\text{sub } 2/\text{divided by } dm/dt$  where  $J$  is current,  $dm/dt$  mass flow rate through the discharge. With increasing values of  $J/\text{sub } 2/\text{divided by } dm/dt$ , the anode fall increases continuously from small negative values, through zero, and up to moderate positive values. Then, within a small increment of  $J/\text{sub } 2/\text{divided by } dm/dt$ , it jumps to values on the order of the ionization potential of the gas. A theoretical two-dimensional description of the flow field indicates that the self-magnetic forces, which are proportional to  $J/\text{sub } 2/$ , pinch the gas towards the discharge axis, thereby leading to particle starvation in the vicinity of the anode. Based upon the results of this study it is shown that, as a consequence of the altering boundary conditions, which are characterized by the parameter  $J/\text{sub } 2/\text{divided by } dm/dt$ , the anode responds by adopting different operating modes. Existing theories yield values for the anode fall which are in good agreement with experimental data. 27 Refs.

Primary Keywords: Gas Breakdown; Low Pressure Discharge; Anode Fall; 6 kA Current; DC Arc; Radial Discharge; Experiment; Theory; 2-d Model; Several Discharge Modes  
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8931  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Electrodes; Gas Gaps, Materials)  
EROSION OF CATHODE MATERIAL IN A PULSED DISCHARGE BETWEEN PARALLEL ELECTRODES

R. Basharov, E.N. Malkin, O.A. Gavrilovskaya and E.S. Trakhov  
Moscow Physical Engineering Institute, Moscow, USSR  
Soviet Physics-Technical Physics, Vol. 12, No. 10, pp 1383-1390  
(04/1988).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 37, 1889-1896 (October 1967)  
Results are presented of a study of the erosion of a copper cathode in a pulsed discharge. The effects of the condition of cathode surface and of the kind and pressure of gas on the character of erosion and on the surface current density were investigated. It was established that the condition of the cathode surface is of great importance. A hypothesis is proposed about the cause of this phenomenon. The experimental data on cathode-material erosion are compared with the results of calculations based on various theories. 14 Refs.

Primary Keywords: Cathode Erosion; Copper Cathode; Cathode Surface Condition; Gas Gap; Variable Gas Pressure; Various Gases; Experiment; Comparison With Theory  
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8932  
(BREAKDOWN STUDIES; SWITCHES, OPENING; BREAKDOWN STUDIES)  
(Vacuum, Electrical; Mechanical; Vacuum, Recovery)  
EXPERIMENTAL INVESTIGATION OF LOW-CURRENT VACUUM ARC INSTABILITIES

K. Frohlich  
Technical University of Vienna, Vienna, Austria  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 4, pp 319-325  
(12/1980).  
The instabilities of 50 Hz low-current vacuum arcs and chopping phenomena were investigated in a test circuit where current was limited either by a resistor or an inductance. Employing a special test method which was developed for statistical evaluation, current zeros were measured oscillographically with a time sweep of 50 to 100 ns/div for durations of 400 div. The effects observed are quantitatively better to assess than with other techniques. It was found that each chopping process is initiated by a partial arc extinction (which as a rule occurs within less than 10 ns). One of the dominant factors of the whole process is the speed of recovery of the contact material (copper contact) showed a much faster recovery and thus higher chopping currents than contacts of copper-tungsten. Furthermore, that current value at which the first instability occurs was measured as well as the corresponding chopping current. Both values were evaluated statistically. In agreement with previous findings the occurrence of the first instability turned out to be independent of the capacitance parallel to the switching gap. However, the chopping current showed a significant dependence on the capacitance, as is well known from earlier investigations. 15 Refs.

Primary Keywords: Vacuum Breakdown; Vacuum Interrupter; Low-current Breakdown; Current Limiting Resistor; Power Line Frequency; Instability; Current Chopping; Several Contact Materials  
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8933  
(BREAKDOWN STUDIES; SWITCHES, OPENING; BREAKDOWN STUDIES)  
(Gas, Electrical; Mechanical; Gas, Recovery)  
EXPERIMENTAL INVESTIGATION ON ARC PHENOMENA IN SF/SUB 6/ PUFFER CIRCUIT BREAKERS

A. Kobayashi, S. Yanabu, S. Yamashita and Y. Dzaki  
Toshiba Corp, Kawasaki, Japan  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 4, pp 339-343  
(12/1980).  
A detailed observation of an arc in a model puffer-type SF/sub 6/ gas circuit breaker in the current range between 10 and 50 kA (rms) has been carried out. It was found that the arc column remained stable on the center axis during the high-current region, then became turbulent near current zero. It was found that the time interval during which the turbulent arc was observed decreased with increasing values of the peak current. These phenomena indicated that the thermal effects of high-current arcs remain even at current zero. It also was observed that the arc diameter at the nozzle throat outlet was smaller than that at the throat (28 mm), even at a current as high as 70 kA (instantaneous), and that the boundary of gas flow at a downstream region had a very large diameter when the arcs were present. However, around current zero the boundary diameter became as small as that without arc. 4 Refs.

Primary Keywords: Gas Blast Circuit Breaker; SF/sub 6/ Gas; 50 kA Current; Arc Instability; Thermal Effects  
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8935  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
FIELD EMISSION FROM VACUUM-DEPOSITED METALLIC FILM AND ITS ROLE IN ELECTRIC BREAKDOWN IN VACUUM

R.N. Sudan and F. Gonzalez-Perez  
Cornell University, Ithaca, NY 14850  
Journal Of Applied Physics, Vol. 55, No. 7, pp 2269-2278 (07/1984).  
An experiment to study the field emission of vacuum gaps has been performed. Copper vapor from an external arc is allowed to condense on a pre-conditioned tungsten filament to study the state of aggregation of the copper deposit. Field emission sites are observed photographically and are found to be elliptical in nature. 6 Refs.  
Primary Keywords: Field Emission; Metallic Film; Emission Centers; Copper Vapor Deposition; Copper Aggregation  
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8937  
(SWITCHES, OPENING; BREAKDOWN STUDIES)  
(Mechanical; Gas, Recovery)  
FREE RECOVERY OF THE GAS-BLAST ARC COLUMN

E. Richey and T. Tuma  
Carnegie Mellon University, Pittsburgh PA 15213  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 4, pp 405-410  
(12/1980).  
The decay of the temperature, velocity, and radius of the extinguished gas-blast arc in SF/sub 6/ and N/sub 2/ is theoretically investigated. The conservation equations for mass, momentum, and energy in integral form and on the axis describe the decay process. Local thermodynamic equilibrium (LTE) is taken to apply for the determination of the material and transport properties of the gases. The influence of the hot gas mantle on the decay of the arc column is taken into account. It is found that the temperature decay of the column in N/sub 2/ is much faster than in SF/sub 6/. Thus the superior dielectric of an arcant with respect to the plasma of N/sub 2/ cannot be explained simply by the temperature decay rates. The predicted rate of decay of the column radius in N/sub 2/ is found to agree well with experimental results. The results of this study are expected to be of value in the determination of the dielectric breakdown characteristics of extinguished arcs. 16 Refs.

Primary Keywords: Gas Blast Circuit Breaker; SF/sub 6/ Blast; N/sub 2/ Blast; Air Temperature; Arc Radius; Theory; Magnetohydrodynamic Model  
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8938  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
HIGH-CURRENT DISCHARGE IN A DENSE PLASMA SOURCE

A.A. Bogomaz, V.S. Borodin, B.P. Levechenko and G.G. Rutberg  
All-Union Institute, Moscow, USSR  
Soviet Physics-Technical Physics, Vol. 22, No. 1, pp 68-75 (01/1977).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 47, 121-133 (January 1977)  
High-current discharges in dense-plasma sources are studied. The working gases are hydrogen, helium, nitrogen, argon, and lithium hydride vapor. The initial hydrogen density is varied over the range 1E-4 to 1E-3 g/cc, the current is varied over the range 50-300 kA, the rate of the rise of the current is varied over the range 1E7 to 1E9 A/sec, and the lifetime over the range 0.5-70 msec. In hydrogen the discharge is turbulent and fills the entire discharge volume. The mechanism by which energy is transferred from the arc to the gas in the discharge chamber is discussed. The energy balance in a turbulent hydrogen arc is examined. 14 Refs.

Primary Keywords: Gas Breakdown; 50-300 kA Current Range; High dI/dt; Several Gases; Energy Balance  
Secondary Keywords: Plasma Source  
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8939  
(BREAKDOWN STUDIES)  
(Electrodes)  
IMPORTANCE OF INSULATING INCLUSIONS IN ARC INITIATION

R. Hancock  
Atomic Energy Research Establishment, Harwell, Berkshire, UK  
British Journal Of Applied Physics, Vol. 11, pp 468-471 (10/1960).  
The initiation of arcs on a metal surface in contact with a plasma (ion density about 1E14 ion/cc) has been studied with metal specimens known to contain microscopic alumina inclusions. The surface conditions with respect to the plasma, and for voltages above 300 V the time lag before arcing occurred was inversely proportional to the positive ion current drawn by the specimen from the plasma, but independent of voltage. At lower voltages the time lag increased rapidly with decreasing voltage. It was concluded that the time lag was due to the ions and the pressure of neutral gas in the plasma. These results are consistent with the initiation of the arcs by dielectric charging and breakdown of the inclusions. 9 Refs.

Primary Keywords: Breakdown; Electrode Insulation Inclusions; Alumina Inclusions; Dielectric Charging; Electrode-plasma Contact; Delay Measurement  
Secondary Keywords: C.T.R. Tube  
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8940  
(BREAKDOWN STUDIES)  
(Electrodes)  
INFLUENCE OF THE COPPER ELECTRODE SURFACE ON INITIAL ARC MOVEMENT

K. Poffel  
Technical University of Vienna, Vienna, Austria  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 4, pp 443-448  
(12/1980).  
To investigate the influence of the copper electrode surface condition on the initial arc movement and the immobility time respectively, a special experimental device was developed. It permits to keep constant, or vary those parameters independently, which influence the initial movement, i.e., arc current (170 A), magnetic flux density (10-1000 x 1E-4 T), electrode distance (1 mm), and surface condition (oxide-film thickness, roughness). The magnetic field can be applied at any moment and can be varied independently of the arc current. The arc is ignited by means of a dielectric breakdown in order to eliminate the ignition effects, such as liquid and vaporizing electrode material. The most striking result of the experiments was that only arc movements of various velocities, but no absolute immobility was measured. This observation is due to the elimination of ignition effects as well as to the use of an adequate sensitive measuring technique. Imposed arc motion characterized by shorter or long lasting creeping (approximately < 3 m/s) occurs, if certain magnetic flux density or copper surface conditions do not permit velocities >10 m/s or if the electrode surface is thermally prestressed by a deliberately standing arc. 19 Refs.

Primary Keywords: Breakdown; Copper Electrodes; Electrode Surface Effect; External Magnetic Field; Independent Parameter Variation; Arc Velocity  
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**8941**  
(BREAKDOWN STUDIES; SWITCHES, OPENING)  
(Vacuum, Electrical; Vacuum Gaps, Magnetic Field)  
INTERACTION BETWEEN VACUUM ARCS AND TRANSVERSE MAGNETIC FIELDS WITH APPLICATION TO CURRENT LIMITATION  
P.R. Enteppe, C.M. Kimbly, J.O. Gorman, F.A. Holmes, J.V.R. Heberlein, R.E. Voshell and P.O. Slade  
Westinghouse Research and Development Center, Pittsburgh PA  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 4, pp 314-319 (12/1980).  
The interaction between diffuse vacuum arcs and magnetic fields applied transverse to the electrode axis has been investigated both theoretically and experimentally. For arc currents <60 kA, Hall electric fields, generated by the interaction, bow the plasma out of contact with the anode and raise the arc voltage. In the presence of a parallel capacitor, the arc current falls to zero and the arc is extinguished. For arc currents of 6 to 15 kA, arc extinction can be achieved with an oscillatory magnetic field; during such extinctions the arc voltage remains in phase with the magnitude of the field. Arc extinction via magnetic field/vacuum arc interaction could have applications to AC-current limiters and DC breakers. The fault current limiter application is discussed in this paper. 17 Refs.  
Primary Keywords: Vacuum Breakdown; Diffuse Vacuum Arc; Transverse Magnetic Field; Hall Effect; Opening Switch  
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**8942**  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES; SWITCHES, OPENING)  
(Gas, Electrical; Gas, Recovery; Mechanical)  
INTERRUPTION CAPABILITY OF GASES AND GAS MIXTURES IN A PUFFER-TYPE INTERRUPTER  
A. Lee and L.S. Frost  
Westinghouse Research and Development Center, Pittsburgh PA  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 4, pp 362-367 (12/1980).

SF<sub>6</sub> gas has been widely used in arc interruption applications for the past 20 years. Reported here is a systematic, comprehensive effort to search for and evaluate gases and gas mixtures suitable as an arc interruption medium potentially superior to SF<sub>6</sub> gas. The search began with several hundred gases, narrowed down to about forty, and finally fifteen gases and gas mixtures were evaluated in a full size puffer-type interrupter under 60-MHz high-power conditions. The results showed SF<sub>6</sub> stood out as having the best interruption ability with several mixtures having approximately 80 percent of SF<sub>6</sub>'s performance. 8 Refs.  
Primary Keywords: Gas Blast Circuit Breaker; Several Gas Mixtures; Relative Interruption Capability; Performance Test; Gas Selection Criteria  
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**8944**  
(SWITCHES, CLOSING)  
(Gas Gaps, Optical)  
KRF LASER-TRIGGERED SF<sub>6</sub>/SUB 6/ SPARK GAP FOR LOW JITTER TIMING  
M.R. Reed, R. Golcher and J.R. Murray  
Lawrence Livermore Lab, Livermore, CA 94550  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 3, pp 167-170 (09/1980).  
KRF laser-triggered spark gaps exploit the high DC-dielectric strength and low ultraviolet (UV) breakdown threshold of SF<sub>6</sub>/SUB 6/ gas. Detailed measurements using a DC-charged pulser demonstrate subnanosecond jitter for switching a 0.5-cm gap operated at 80 kV with 7 mJ in 20 ns of 248-nm KRF radiation. A 200-kV pulse-charged 0.7-cm gap gives similar performance. 11 Refs.  
Primary Keywords: Laser Triggered Spark Gap; KRF Laser; SF<sub>6</sub>/SUB 6/ Gap; DC Charging; 80 kV Operating Voltage; 7 mJ Laser Pulse  
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**8947**  
(POWER CONDITIONING; POWER CONDITIONING)  
(Pulse Transformers, Materials; Saturable Reactors, Materials)  
METALLIC GLASSES: A MAGNETIC ALTERNATIVE  
D. Raskin (1) and L.A. Davis (2)  
(1) Allied Corp., Parsippany, NJ  
(2) Allied Corp., Morristown, NJ  
IEEE Spectrum, Vol. 18, No. 11, pp 28-33 (11/1981).  
The state-of-the-art in manufacture and application of metallic glasses is the subject of this paper. Recent improvements in manufacturing techniques are discussed qualitatively with predictions on future growth presented. Some of the properties of metallic glasses are shown. Present and future applications are noted. 14 Refs.  
Primary Keywords: Metallic Glass; Properties; Manufacturing Technology; Applications  
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**8951**  
(ENERGY CONVERSION, THERMAL)  
(Magnetohydrodynamic)  
NUMERICAL STUDY OF UNSTEADY PROCESSES IN A FARADAY MHD GENERATOR  
G.M. Vinogradova and V.P. Panchenko  
I.V. Kurchatov Institute of Atomic Energy, Moscow, USSR  
High Temperature, Vol. 19, No. 1, pp 127-133 (02/1981).  
Trans. From: Teplofizika Vysokikh Temperatur 19, 164-171 (January-February 1981).  
Unsteady processes in a Faraday MHD generator with high power-conversion coefficient are numerically studied. The establishment of steady operating modes of an MHD generator with continuous electrodes is studied when an ohmic load is connected, disconnected, or reduced. A central difference predictor-corrector scheme is used to numerically solve the partial differential equations. 10 Refs.  
Primary Keywords: MHD Generator; High Power-conversion Coefficient; Unsteady Process; Continuous Electrodes; Theory; Numerical Calculation  
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**8952**  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
ON THE INITIATION OF ELECTRICAL BREAKDOWN OF A HIGH VACUUM GAP  
N.B. Rosanova and V.L. Granovskii  
Soviet Physics Technical Physics, Vol. 1, No. 3, pp 471-478 (02/1957).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 26, (1956).  
Measurements of the static and pulsed breakdown voltages of vacuum gaps between conductors made of various metals (Al, Cu, Fe, Ni, Mo, U) and of graphite, have shown that the breakdown voltage of the gap U<sub>sub</sub> gap/ increases with an increase in the mechanical strength of the material of the anode. There is no causal connection between the onset of breakdown and the intensity of the x-radiation from the anode in the prebreakdown stage contrary to a hypothesis put forward in this connection in the literature. 19 Refs.  
Primary Keywords: Vacuum Breakdown; Static Breakdown Voltage; Pulsed Breakdown Voltage; Several Electrode Materials; Anode X-ray Irradiation  
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**8954**  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
PAUSE IN PLASMA EMISSION AFTER NANOSECOND-PULSE EXCITATION  
R.Kh. Amirov, E.I. Asimovskii and V.V. Markovets  
Academy of Sciences of the USSR, Moscow, USSR  
High Temperature, Vol. 19, No. 1, pp 37-46 (02/1981).  
Trans. From: Teplofizika Vysokikh Temperatur 19, 47-51 (January-February 1981).  
A study has been made of the characteristics of a glow discharge after perturbation by nanosecond pulse. There is a pause in the plasma emission lasting some tens of microseconds. A model is proposed that explains the results in terms of an excess electron concentration, which reduces the electron temperature and thus reduces the emission intensity. 16 Refs.  
Primary Keywords: Glow Discharge; Nanosecond Pulse Perturbation; Plasma Emission Pause; Modeling; Electron Temperature Reduction  
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**8956**  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES; SWITCHES, OPENING)  
(Gas, Electrical; Gas, Recovery; Mechanical)  
PRESSURE TRANSIENTS IN A MODEL GAS-BLAST CIRCUIT BREAKER OPERATING AT EXTRA HIGH CURRENT LEVELS  
J.L. Leclerc, M.R. Smith and G.R. Jones  
University of Liverpool, Liverpool, UK  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 4, pp 376-384 (12/1980).  
Test results for model circuit breakers operating at high current levels and with large diameter nozzles show evidence of pronounced pressure transients although the circuit breaker nozzle is not severely blocked. The magnitude and duration of these transients are sufficient to affect the arc properties and hence influence arc control during the peak current phase and to influence arc extinction at current zero. However, despite their inherent importance there exists only limited information concerning such pressure variations. The purpose of this contribution is to identify the nature and sources of the transients, to establish typical thresholds for the onset of the transients, and to determine the influence of different operating conditions upon the transients. Measurements of pressure and thermal mantle variations are used in conjunction with an electrical analog model of the aerodynamic test facility to show that the pressure transients arise not only from arc generated flow impedance effects but also aerodynamic resonances. The resonant pressure transients are shown to be pronounced during the high current phase even below the thermal blocking threshold. Above the threshold, excitation of negative increment resonance following current peak produces depressed pressure during the current-zero period which may lead to a deterioration in circuit breaker performance. Higher frequency resonances also occur and become more pronounced with electrode wear. 10 Refs.  
Primary Keywords: Gas Blast Circuit Breaker; Model Breaker; Pressure Transients; 100 kA Current; Modeling  
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**8957**  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
PROPERTIES OF ANCHORED CATHODE SPOTS OF A DC MERCURY VACUUM ARC  
G. Eckhardt  
Hughes Research Labs, Malibu, CA 90265  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 4, pp 295-301 (12/1980).  
Ensembles of anchored cathode spots of a DC mercury vacuum arc have been studied by fast framing and streak photography. From these photographs, several statistical properties of the cathode spots have been determined: distribution functions for their diameters, velocities, and displacements, as well as spot shape and average values for the spot current and its density. The measurements showed that the anchored cathode spots were quasi-stationary. No indications of a microstructure within the individual cathode spots were found at an optical resolution of 0.37 micron. Strong evidence is presented that the DC cathode spot parameter values reported here are typical for a clean mercury surface, and that those reported in the earlier literature are typical for impurity-covered surfaces. 18 Refs.  
Primary Keywords: Vacuum Breakdown; Mercury Arc; Cathode Spot; Spot Diameter; Spot Velocity; Spot Current; Quasi-stationary Spot; No Microstructure; Photographic Diagnostic  
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**8959**  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
QUALITATIVE MODEL OF INITIATION OF A VACUUM ARC I. BREAKDOWN MECHANISM  
G. Furin and P.M. Vorontsov-Velyaminov  
A.A. Zhdanov Leningrad State University, Leningrad, USSR  
Soviet Physics-Technical Physics, Vol. 12, No. 10, pp 1370-1376 (04/1968).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 37, 1870-1879 (October 1967).  
The effect of microinhomogeneities on the development of breakdown in a vacuum gap is examined. It is shown that the field intensification in the presence of practically realizable microinhomogeneities can attain values >100. A mechanism of vacuum breakdown based on the explosive destruction of a cathode microinhomogeneity as the primary act of initiation is proposed. 55 Refs.  
Primary Keywords: Vacuum Breakdown; Microprojections; Field Intensification; Microprojection Explosion; Breakdown Initiation  
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8961  
(BREAKDOWN STUDIES; SWITCHES, OPENING)  
(Gas, Electrical; Gas, Recovery; Mechanical)  
QUENCHING PROCESSES OF AXIALLY INHOMOGENEOUS ARCS IN SF/SUB 6/ CIRCUIT BREAKERS  
E.V. Bonin, G. Bruggemann and H.G. Thiel  
High Voltage Institute, Kassel, FRG  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 4, pp 344-351  
(12/1980).

The description of the arc in a modern high-voltage SF/sub 6/ circuit breaker by only one single-arc equation is not sufficiently exact for applications, especially when using constant arc parameters. In typical nozzle configurations, arcs are generally being axial inhomogeneous. For these arcs, a theory is presented taking into account the gas-flow properties determining the axial structure. This is applied for investigating an arc consisting essentially of two different parts. It is shown, how to determine for these parts the arc parameters depending on the conductances, which are required for an appropriate mathematical description. As an example a computer simulation of the performance of the investigated circuit breaker is presented, and compared with corresponding full-scale interruption tests. Breaking capacity limit as well as the complete interaction phenomena between circuit breaker and test circuit are in agreement, proving the presented theory of an axially inhomogeneous arc. 11 Refs.

Primary Keywords: Circuit Breaker; Arc Quenching; Numerical Calculation; Experiment; Theory; Dependence On Flow Properties  
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8962  
(BREAKDOWN STUDIES; SWITCHES, OPENING)  
(Gas, Recovery; Mechanical)  
QUENCHING PROPERTIES OF AN ARC IN A DOUBLE FLOW WITH A VORTEX  
Ch. Sturzenegger, R.T. Reinhardt and H.J. Schotzau  
Sprecher and Schuh Ltd, Aarau, Switzerland  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 4, pp 384-389  
(12/1980).

The effect of a vortex in a gas flow on an air-blast arc is investigated. The radial density of a vortex in the compressible flow is evaluated with a simple model. The experiments show that the width of a low pressure channel on the axis of the nozzle is comparable to the theoretical values. The measured electric field strength profile is strongly influenced by the presence of such a vortex. In addition, the thermal interruption capability is critically lowered by vortex superimposed on the axial gas flow. 7 Refs.

Primary Keywords: Arc Quenching; Double Flow Nozzle; E-field Measurement; Vortex; Interruption Capability Reduction  
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8964  
(BREAKDOWN STUDIES; SWITCHES, OPENING; BREAKDOWN STUDIES)  
(Gas, Electrical; Mechanical; Gas, Recovery)  
SCALING LAWS FOR GAS-BLAST CIRCUIT-BREAKER ARCS DURING THE HIGH CURRENT PHASE  
H.T.C. Fang (1), S. Ramakrishnan (2) and M.K. Messerle (1)  
(1) University of Sydney NSW, Australia  
(2) University of Liverpool, Liverpool, UK  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 4, pp 357-362  
(12/1980).

A steady state nozzle arc model based on the boundary layer integral method is established and scaling laws are derived. For affinely related nozzles, the solution is uniquely determined by a nozzle coefficient M, which is related to the stagnation conditions, the arc current, and the dimensions of the nozzle. Tests have been performed on nozzle arcs in air using two geometrically similar nozzles at three stagnation pressures. A good agreement between theory and experiment is obtained which indicates that circuit-breaker arcs can be scaled. To avoid nozzle clogging, the nominal current density at the throat ( $I/A_{sub\ t}$ ) should not exceed the highest permissible nominal current density at the throat. For all affinely related nozzles, this upper limit of current density at the throat is proportional to  $(p_{sub\ 0}/\rho)^{1/2}$  divided by  $z_{sub\ t}/r$  to the 1/2 power, where  $p_{sub\ 0}$  is the stagnation pressure and  $z_{sub\ t}/r$  the distance of the throat from the nozzle entrance. The overall arc voltage exhibits the pre-current-zero static behavior as indicated by Browne's composite arc model. 12 Refs.

Primary Keywords: Nozzle Arc; Steady State Arc; Arc Modeling; Gas Blast Circuit Breaker; Nozzle Coefficient; Affinely Related Nozzle; Theory  
COPYRIGHT: 1980 IEEE, REPRINTED WITH PERMISSION

8966  
(SWITCHES, OPENING; BREAKDOWN STUDIES; BREAKDOWN STUDIES)  
(Mechanical; Gas, Electrical; Gas, Recovery)  
SIMPLIFIED ESTIMATION OF CRITICAL QUANTITIES FOR SHORT-LINE FAULT INTERRUPTION

T.E. Browne Jr.  
Westinghouse Research and Development Center, Pittsburgh PA  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 4, pp 400-405  
(12/1980).

From analyses of equations derived in a previous paper for critical interrupting conditions for an arc shunted by both resistance and capacitance in parallel, or for short-line fault interruption with capacitance shunting, further analytical expressions useful for prediction of limiting conditions are derived. Examples, based on observed relations of Cassie-Mayr arc model parameters to current rate of change for a particular SF/sub 6/ blast circuit breaker, show realistic plots of limiting short-line fault currents versus line length with capacitance shunting. Also shown are required capacitance shunt values as functions of busfault current, fault fraction, line length, and number of series breaks. Included in the equations are circuit voltage and frequency and line surge impedance. Finally, it is shown that similar relations can be derived by using an approach suggested by A.M. Cassie in 1939. 6 Refs.

Primary Keywords: Gas Blast Circuit Breaker; Circuit Parameter Interaction; Cassie-Mayr Arc Model  
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8968  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
SPECTROSCOPIC APPROACH TO THE ANALYSIS OF HIGH CURRENT ARCS IN SF/SUB 6/ S. Okuda (1), Y. Ueda (1), Y. Murai (1), T. Miyamoto (1), Y. Doi (2) and C. Uenosono (2)  
(1) Mitsubishi Electric Corp, Amagasaki, Japan  
(2) Kyoto University, Yoshida Hon-machi, Sakyo-ku, Kyoto, Japan  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 4, pp 395-399  
(12/1980).

Spectroscopic observations were carried out on transient free-burning arcs drawn by separating copper/tungsten electrodes in SF/sub 6/ gas. The peak value of the arc current was varied up to 60 kA. A new optical method was developed to measure temperature and pressure profiles of the arc taking the magnetic pinch force into account. The arc voltage calculated from the obtained temperature and pressure profiles agreed well with electrical measurements. The results made it clear that the composition of the arc changes significantly at the critical instantaneous current of 10 kA. Above 10 kA the arc is composed of the electrode vapor, while it contains SF/sub 6/ gas below 10 kA. 6 Refs.

Primary Keywords: SF/sub 6/ Breakdown; 60 kA Arc Current; Spectroscopic Diagnostic; Arc Temperature Profile; Arc Pressure Profile; Calculated Arc Voltage; Comparison With Measured Voltage  
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8971  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
SWITCHING CHARACTERISTICS OF A THREE-ELECTRODE SPARK GAP  
G.A. Vorobiev and G.S. Korshunov  
Tomsk Polytechnic Institute, Tomsk, USSR  
Soviet Physics-Technical Physics, Vol. 12, No. 9, pp 1251-1254  
(03/1968).

Trans. From: Zhurnal Tekhnicheskoi Fiziki 37, 1707-1711 (September 1967)

The switching characteristics of a three-electrode spark gap with an auxiliary 'heater' capacitance operating under atmospheric conditions are discussed. It is shown that the switching time is affected by the magnitude of the 'heater' capacitance, the overvoltage across the second spark gap, the mutual irradiation of the spark gaps in the process of discharge, and the circuit inductance. The shortest pulse rise time was 1.5E-8 sec. 5 Refs.

Primary Keywords: Three-electrode Spark Gap; Start Capacitor; 15 kV Operating Voltage; 200 A Current; Nanosecond Rise Time  
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8972  
(BREAKDOWN STUDIES; DIAGNOSTICS AND INSTRUMENTATION)  
(Gas, Electrical; Miscellaneous)  
TEMPERATURE DIAGNOSTICS IN TURBULENT ARCS

Y.K. Chien and D.M. Benenson  
State University of New York at Buffalo, Buffalo, NY 14226  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 4, pp 411-417  
(12/1980).

Time averaged radial distribution of temperature and its fluctuations have been obtained for turbulent (and laminar) DC-argon arcs operated at 65 A in a 1-cm diam channel. With laminar arcs fluctuations proceeded inward from the outer edge; in the present case temperature fluctuations were about 1 percent and 4 percent at the center-line and outer edge, respectively. Relatively large fluctuations in temperature, about 5 percent, were found across the entire column where the arc was turbulent. Counterline temperatures were nearly identical for both laminar and turbulent arcs-about 18610 Deg.K. The analytical development is an extension of the model of Schreiber and Hunter. 24 Refs.

Primary Keywords: Turbulent Arc; Temperature Diagnostic; DC Arc; Argon Gas; 65 A Current; 5 Percent Temperature Variation  
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8974  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
THE EFFECTS OF COLD GAS INJECTION ON A CONFINED ARC COLUMN

D.M. Chen, K.C. Hsu, C.H. Liu and E. Pfender  
University of Minnesota, Minneapolis, MN  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 4, pp 425-430  
(12/1980).

This paper considers the interaction of a thermal argon arc plasma confined in a relatively long water-cooled cylindrical tube with a cold argon flow injected radially into the tube through a circumferential slit. An analytical model is established to predict the thermal, the fluiddynamic, as well as the electrical behavior, of such an arc assuming laminar flow and local Thermodynamic Equilibrium (LTE) of the arc plasma. Numerical solutions for the field variables are obtained by solving simultaneously the mass, momentum, energy, and charge conservation equations by an iterative finite difference method. The results show that the arc column becomes constricted at the location of gas injection due to thermal and fluiddynamic effects associated with the injected cold flow. The arc responds to the constriction by an increase of the temperature in the core region which resists the penetration of the cold flow into the arc. This penetration remains relatively small even at high injection ratios because the arc temperature and, therefore, the resistance to flow penetration increases with increasing injection ratio. The enhanced Joule heating in the injection region leads to a minor thermal expansion of the base flow which can be observed upstream of the injection slit. This effect becomes less pronounced as the injection mass flow rate increases. 12 Refs.

Primary Keywords: Confinement Arc; Argon Arc; Cold Argon Injection; Theory; Analytical Model; Numerical Calculation  
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8977  
(SWITCHES, OPENING)  
(Explosive Fuses)  
THE VOLTAGE ACROSS A FUSE DURING THE CURRENT INTERRUPTION PROCESS  
L. Verma  
NOLCE N.V., Utrecht, Netherlands  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 4, pp 460-468  
(12/1980)  
Results of experiments with fusing wires are discussed and explained theoretically. Multiple arcing is observed; it is explained in a thermodynamic model. Also, the possible absence of multiple arcing at high currents is explained. There, evaporation of superheated fuse material causes the fast increase of the fuse resistance. This evaporation explains the experimentally observed behavior of the fuse resistance as a function of fuse diameter, whereas the concept of multiple arcing fails to do so. Results from experiments confirm energy balance equations, both for fuses in air and for fuses embedded in fine-grained sand. The energy balance equation for the latter case is shown to be equivalent to Mayr's equation. 20 Refs.  
Primary Keywords: Fuse; Multiple Arcing; Fuse Resistance; Theory; Energy Balance Equation; Mayr's Equation  
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8978  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES; SWITCHES, OPENING)  
(Gas, Electrical; Gas, Recovery; Mechanical)  
THEORETICAL AND EXPERIMENTAL INVESTIGATION OF THE STOCHASTIC BEHAVIOR OF SF<sub>6</sub> SUB 6/ BLAST-SWITCHING ARC  
K. Moller, R. Schmidt and B. Sporkmann  
High Voltage Lab, Aachen, FRG  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 4, pp 352-356  
(12/1980)  
This paper deals with some fundamental guidelines for the establishment of a stochastic arc model. Its aim is to describe the well known statistical behavior of the interrupting limit of circuit breakers taking into account short time fluctuations of the arc properties. This stochastic arc model is based on a phenomenological arc description regarding the switching arc as an electric two-pole. The arc parameters are no longer understood as deterministic functions but as stochastic processes. Their probability density distributions and the respective autocovariance and crosscovariance functions are the mathematical means to establish the model. Pseudorandom generators are used to compute switching processes of an electrical network connected to a stochastic arc. Experiments of an SF<sub>6</sub> sub 6/ model circuit breaker were carried out with respect to the statistical behavior of its current, arc voltage, conductivity, and interrupting limit. From these experiments the necessary arc parameters were taken in an iterative strategy. With these parameters it was possible to reach good agreement between measured and calculated values of the failure probability of the breaker under test. 8 Refs.  
Primary Keywords: SF<sub>6</sub> sub 6/ Breakdown; Gas Blast Circuit Breaker; Arc Modeling; Breaker Opening Limit; Statistical Analysis; Experiment; Theory  
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8979  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
THEORETICAL MODEL FOR BREAKDOWN OF FLASH-DISCHARGE TUBES CAUSED BY INTERNAL PRESSURE DURING VAPORIZATION OF WALL MATERIAL  
V.V. Ivanov, A.I. Kobzar', V.A. Frolova and A.G. Rozonov  
Moscow, USSR  
High Temperature, Vol. 19, No. 1, pp 137-141 (02/1981)  
Trans. From: Teplofizika Vysokikh Temperatur 19, 177-181 (January-February 1981)  
A theoretical model is proposed for breakdown of flash-discharge tubes caused by internal pressure during vaporization of the wall material. An analytic expression is obtained for the limiting energy of a flash-discharge tube by solving the heat-conduction equations successively for the heating stage and wall vaporization stage. It is shown that the theoretical calculations and known experimental data are in satisfactory quantitative agreement. 18 Refs.  
Primary Keywords: Gas Breakdown; Thermal Conduction; Wall Vaporization; Pressure Increase; Theory; Comparison with Experiment  
Secondary Keywords: Flash Tube  
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8980  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
THEORY OF POWERFUL NONSTEADY XENON DISCHARGE TAKING VAPORIZATION OF ITS STABILIZING WALLS INTO ACCOUNT  
V.M. Gradov, V.V. Ivanov, Yu.I. Terent'ev and A.A. Shcherbakov  
High Temperature, Vol. 19, No. 1, pp 22-28 (02/1981)  
Trans. From: Teplofizika Vysokikh Temperatur 19, 28-35 (January-February 1981)  
A complex mathematical model of a nonsteady xenon discharge of average duration (10-100 microseconds) is developed, taking into account the quartz walls into account. The processes in the pulse lamp in conditions of wall vaporization are investigated theoretically and experimentally. 23 Refs.  
Primary Keywords: Xenon Discharge; Pulsed Discharge; Wall Stabilization; Quartz Wall; Modeling; Experiment; Theory  
Secondary Keywords: Flashlamp Operation  
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8981  
(BREAKDOWN STUDIES)  
(Gas, Recovery)  
THERMAL LAYERS IN POSTARC CHANNEL  
Z. Kolacinski  
Technical University of Lodz, Lodz, Poland  
IEEE Transactions On Plasma Science, Vol. PS-8, No. 4, pp 449-454  
(12/1980)  
The subject of the investigation is a short arc burning in air between electrodes made of refractory materials. Based on measurements of the electrical conductivity of near-electrode regions, as well as on calculations, it is stated that thermal reignition takes place in a thermal layer near the new anode. In the paper, a model of short arc thermal reignition is presented and the results of calculations are compared with measurements. These results shed light on postarc conditions in low voltage circuit breakers. 7 Refs.  
Primary Keywords: Postarc Channel; Temperature Measurement; Electrical Conductivity Measurement; Arc Reignition; Thermal Reignition  
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8982  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Vacuum, Electrical; Vacuum Gaps, Electrical)  
TIME DELAY IN TRIGGERED VACUUM GAP  
A.W. Hull  
General Electric Co. Schenectady, NY 12301  
IEEE Transactions On Electron Devices, Vol. ED-13, No. 6, pp 529-530  
(06/1966)  
A proposed theory of metal vapor arcs in vacuum, based on the assumption of field emission of electrons, has been used to calculate the time delay of Lafferty's Triggered Vacuum Gap, with excellent agreement with experiment. 7 Refs.  
Primary Keywords: Vacuum Breakdown; Field Emission; Vacuum Spark Gap; Delay Measurement; Theory  
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8984  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
A CATHODE SPOT MODEL AND ITS ENERGY BALANCE FOR METAL VAPOUR ARCS  
J. Daalder  
Eindhoven University of Technology, Eindhoven, Netherlands  
Journal Of Physics D: Applied Physics, Vol. 11, No. 12, pp 1667-1682  
(08/1978)  
A non-stationary cathode spot model is proposed which is based on an interpretation of experimental data recently obtained. The significance of ion mass generation by Joule heating and the separation of energy flows associated with electron and ion currents in the cathode spot are the main differences with other known cathode spot models. The ion energy balance at the metal-vacuum transition is evaluated quantitatively and applied to a calculation of the ion fraction in the cathode current. For a broad range of metals and independent of the electron emission mechanism, minimum and maximum ion current fractions are found of around 10% and 20%, respectively. By considering IF emission it is shown that the ion currents oriented from and towards the cathode have the same size, each being 10% of the arc current or somewhat higher. The dominant influence of the electric field on the electron emission is established. This result is in agreement with the total ion mass produced by Joule heating in the cathode as has been previously calculated for the same range of metals. 49 Refs.  
Primary Keywords: Vacuum Breakdown; Cathode Spot; Joule Heating; Ion Generation; Electron Current; Ion Current; Modeling; Field Emission  
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8985  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
COMPONENTS OF CATHODE EROSION IN VACUUM ARCS  
J.E. Daalder  
Eindhoven University of Technology, Eindhoven, Netherlands  
Journal Of Physics D: Applied Physics, Vol. 9, No. 16, pp 2379-2386  
(11/1976)  
The composition of cathode mass loss was analysed for cadmium, copper and molybdenum vacuum arcs. It showed that two dominant flows are present, one consisting of ions, the other of molten droplets which have sizes in the order of microns to tens of microns. The droplet flow is mainly oriented along the cathode plane and is strongly dependent on the fusion temperature of the cathode metal and the charge transfer by the arc. The cathode mass loss in vapour form is considered to be small. 26 Refs.  
Primary Keywords: Cathode Erosion; Cadmium Cathode; Copper Cathode; Molybdenum Cathode; Mass Loss Measurement; Ion Migration; Metal Droplet Flow; Charge Transfer Dependence  
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8987  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Systems)  
DIGITAL IMPULSE RECORDER FOR HIGH-VOLTAGE LABORATORIES  
P. Malowski and A. Dechamps  
Hydro-Quebec Institute of Research, Varannes, Quebec, Canada  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-99, No. 2, pp 636-649 (04/1980)  
A digital recorder has been developed for use in HV laboratories as a prospective replacement for conventional impulse oscilloscopes. The new apparatus has a sufficiently high time resolution to record the fastest microsecond impulses used for HV testing and also allows slower switching transients to be monitored. In order to minimize the sensitive electronic circuits of the recorder against the high electromagnetic interference of HV test areas, the authors conducted an experimental study of the nature of this interference and its magnitude and used the results to calculate the shielding and supply line conditioning systems. The recorder is designed as a mobile unit composed of an input attenuator-compatible with the impulse voltage dividers, an analog-to-digital converter, an interface and a graphic computer terminal. The recorded impulses are displayed with the calibrated voltage and time axes on the terminal screen and can be printed or stored on magnetic tape for further processing. The paper points out new problems ensuing from the application of digital recorders to the HV impulse testing technique. 12 Refs.  
Primary Keywords: Digital Impulse Recorder; HV Resolution; Stand Alone System; Noise Sensitivity Analysis  
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8988  
(SWITCHES, CLOSING)  
(Gas Gaps, Crossed-field)  
FEASIBILITY OF A HIGH AVERAGE POWER CROSSED FIELD CLOSING SWITCH  
M.A. Lutz, R.J. Harvey and H. Altshuler  
Hughes Research Lab., Malibu, CA 90263  
IEEE Transactions On Plasma Science, Vol. PS 4, No. 2, pp 118-128  
(06/1976)  
Results of an experimental program to determine the feasibility of using a crossed field device as a high average power triggered closing switch are reported. The tube contained coaxial cylindrical electrodes and was triggered by pulsing a magnetic field (0.1 T) to a value sufficiently high to trap electrons and initiate conduction. Holdoff voltages up to 60 kV were achieved, with peak (circuit limited) currents as high as 20 kA and pulse durations in the range of 1 to 100 microseconds. Ignition jitter was approximately 0.1 microseconds and the voltage recovery rate was 2 kV/microsecond after 20 kA conduction and a 50 microsecond deionization time. These single and double shot data indicate that it should be possible to build such a device to operate at high average power levels for use in high power (PW) modulators. 9 Refs.  
Primary Keywords: Crossed Field Closing Switch; Coaxial Switch; Magnetic Trigger; 60 kV Operating Voltage; 20 kA Current; 100 ns Jitter; High Average Power  
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8998  
(ELECTROMAGNETIC FIELD GENERATION; PULSE GENERATORS; POWER CONDITIONING)  
(Magnetic; Capacitor Banks; Pulse Forming Lines)  
PRODUCTION OF PULSED MAGNETIC FIELDS WITH FLAT PULSE TOP OF 440 KOE  
AND 1 MSEC DURATION

G. Dworschak, P. Naberey, P. Hildebrand, E. Kneller and D. Schreiber  
Institut für Marktstoffe der Elektrotechnik, Ruhr-Universität Bochum, FRG  
The Review of Scientific Instruments, Vol. 45, No. 2, pp 243-249  
(02/1974)

A capacitance discharge unit for the production of pulsed magnetic fields up to 440 kOe is described. The pulse formed by a passive network has a field plateau of approximately 1 msec duration for a half-period of approximately 3.5 msec and a field ripple of delta H/H < 1%. The unit occupies approximately 10 sq m., the total weight is 600 kg. It can be produced at low cost. 22 Refs.

Primary Keywords: Magnetic Field Generation; Air Core Coil; Mechanical Analysis; Pulse Forming Network; 2.5 kV Output Voltage; 1 ms Pulse Width; Rectangular Pulse; Thyristor

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8999  
(BREAKDOWN STUDIES)  
(Gas; Electrical)

INTEGRAL METHODS OF ANALYSING ELECTRIC ARCS: I. FORMULATION  
M.D. Cowley  
University of Cambridge, Cambridge, CB21PZ  
Journal Of Physics D: Applied Physics, Vol. 7, No. 16, pp 2218-2231  
(11/1974)

The equations of continuity, momentum and energy are derived for axisymmetric electric arcs in terms of overall radial integrals. The external flow is assumed to be adiabatic, reversible and one-dimensional, although compressibility and the possibility of time variation are included. The overall integrals define quantities with the dimension of area when their integrands are normalized. Arc problems can then be solved in principle if relations between the area quantities can be guessed or found empirically, and a formal structure for such empiricism is suggested. It is shown that the enthalpy-flow model of Frost and Liebermann is equivalent to an integral method at a low level of approximation. The analyses of Tochan are related to the present general information. 12 Refs.

Primary Keywords: Gas Breakdown; Axial Gas Flow; Theory; Magnetohydrodynamic Analysis; Theory; Empirical Area Relations

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8992  
(BREAKDOWN STUDIES)  
(Gas; Electrical)

INVESTIGATIONS OF GLOW DISCHARGE FORMATION WITH VOLUME PREIONIZATION  
L.E. Kline and L.J. Denes  
Westinghouse Research and Development Center, Pittsburgh PA  
Journal Of Applied Physics, Vol. 46, No. 4, 1567-1574 (04/1975)

The discharge formation process has been studied experimentally for CD/sub 2/ planar TEA laser discharges. Theoretical models are presented which predict the preionization electron and ion densities, the spatiotemporal development of the discharge plasma, discharge voltage, and current waveform, and the quasi-steady operating characteristics of the discharge. The preionization is provided in the experiments by a pulse of ultraviolet radiation. The discharge formation model accounts for cathode photoemission and anode collection of electron discharge-circuit interactions, and gaseous ionization processes. The model predicts that photoemission and anode collection can be neglected when strong preionization and moderate overvoltages are used. When photoemission and anode collection are neglected, the discharge formative time is independent of the discharge volume. Calculated and experimental voltage and current waveforms are in very good agreement. The results of the calculations show that the discharge formative time is determined primarily by the characteristics of the external circuit in the experiments. Formation calculations for a large-volume discharge show that a uniform glow discharge will develop even when the preionization is nonuniform along the electric field, and confirm that the formative time is approximately independent of the discharge volume. 38 Refs.

Primary Keywords: Glow Discharge; Ultraviolet Preionization; Volume Preionization; Theory; Plasma Development; Discharge Voltage; Discharge Current; Comparison With Experiment

Secondary Keywords: Gas Laser Pumping

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8993  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Current)

ON THE HIGH-FREQUENCY RESPONSE OF A ROGOWSKI COIL

J. Cooper  
Imperial College Of Science And Technology, London, UK  
Plasma Physics (Journal Of Nuclear Energy Part C), Vol. 5, No. 5, pp 285-289 (01/1963)

In this paper a Rogowski coil with a capacitive shield is treated as a distributed circuit, so that the toroidally wound coil acts as a delay line. It is shown that, in general, the high-frequency response is limited by the transit time around this delay line, and for times greater than this transit time the individual circuit elements act as lumped impedances. However, if the flow of the current to be measured is such that it is symmetrical with respect to the toroidal coil (so that the voltage induced per unit length along the coil, when the current changes, is constant), the transient response becomes less than the transit time for a termination whose impedance is small compared with that of the toroidal coil. The best results may be obtained with an inductive termination whose impedance has the same phase angle as the impedance of the toroidal coil, and for this termination the output is proportional to the rate of change of current. 6 Refs.

Primary Keywords: Rogowski Coil; Capacitive Shield; Modeling; Delay Line; No Transit Time Limitation

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8994  
(BREAKDOWN STUDIES)  
(Exploding Wires)

OPTIMIZATION OF ENERGY CONVERSION IN ELECTRICAL EXPLOSION OF A CONDUCTOR IN A LIQUID

V.K. Rakhuba and N.N. Stolyov  
Institute Of Heat And Mass Transfer, Academy of Sciences of the Belorussian SSR, Minsk, USSR  
Soviet Physics-Technical Physics, Vol. 18, No. 6, pp 775-778 (12/1973)  
Trans. From: Zhurnal Tekhnicheskoi Fiziki, 43, 1222-1237 (June 1973)

Optimum relations between the dimensions of the exploding conductor and the parameters of the discharge circuit are found from the condition maximizing the efficiency for the conversion of electrical energy stored in a capacitor into the mechanical energy of the deformation of cylindrical thin-walled transducers. Comparison shows good agreement between theory and experiment. 15 Refs.

Primary Keywords: Exploding Wire; Liquid Environment; Wire Dimensions; Discharge Circuit Parameters; Optimization; Experiment; Theory; Good Agreement

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8995  
(BREAKDOWN STUDIES)  
(Gas; Diagnostics)

PHOTOELECTRIC SPECTROSCOPY OF TRANSIENT DISCHARGES  
Tsui-Fang, C.M., Cundell, J.D., Craggs  
University of Liverpool, Liverpool, UK  
Spectrochimica Acta, Vol. 5, pp 452-459 (01/1953)

Details are given of various optical techniques used with photomultiplier tubes in the measurement of the relative intensities of spectral lines in the emission spectra of transient discharges, notably sparks lasting a few microseconds. 20 Refs.

Primary Keywords: Gas Discharge; Spectroscopy; Optical Techniques; Transient Discharge; Calibration Techniques

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8996  
(PARTICLE BEAMS, ELECTRON)  
(Generation)

KAL'MAR-1 PULSED ELECTRON ACCELERATOR WITH RELATIVISTIC ELECTRON BEAM POWER OF UP TO 5E12 W/SQ.CM.

B.A. Demidov, M.V. Ivkin, V.A. Petrov and S.D. Fanchenko  
Soviet Atomic Energy, Vol. 46, No. 2, pp 111-116 (02/1979)  
Trans. From: Atomnaya Energiya 46, 109-104 (February 1979)  
The possibility of achieving controlled thermonuclear fusion by using relativistic electron beams (REB), first pointed out by Zavoitskiy, is arousing ever-increasing interest. As shown by Rudakov, REB with a current of the order of 1E7 A and a power density of the order of 1E13 W/sq.cm. are required to accomplish this. The present paper describes the Kal'mar-1 accelerator producing REB with a power density of 5E11 - 5E12 W/sq.cm. We give the results of investigations on REB focusing in a high-voltage diode as a function of the electrode geometry and the magnitude of the voltage prepulse. 14 Refs.

Primary Keywords: Kal'mar-1 Accelerator; Field Emission Diode; 1 MeV Electrons; 10 MA Current; 1.5 Ohm Diode Impedance; Trigonon

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8997  
(BREAKDOWN STUDIES)  
(Gas; Corona)

PULSES IN NEGATIVE POINT-TO-PLANE CORONA  
L.B. Loeb, A.F. Kip and G.G. Hudson  
University of California, Berkeley CA  
Physical Review, Vol. 60, pp 714-722 (11/1941)

The failure of W.H. Bennett working with very fine negative points and of G.G. Hudson working with larger carefully polished negative Pt points in clean dry dust-free air to observe the regular relaxation oscillator-like pulses reported by Trichel for negative points in room air led to a further study of the Trichel pulses. It was found by Kip and Bennett independently that the onset potentials and the current-voltage characteristics of the corona showing Trichel pulses are independent of the metal and thus of the work function of the point. It is further independently shown by Bennett and by Hudson that the regular Trichel pulses originating as they do in the gas require the presence of a source of triggering electrons. These can be furnished from fine points or by roughness on larger points through field emission, by very fine dust specks. Thus room air, yielding negative ions and providing ample numbers of fine dust specks for triggering, yields the regular Trichel pulses while clean, dry dust-free air, giving but rare dust specks, yields random bursts of pulses of irregular form. The theory of the phenomenon is reconsidered in the light of the findings and it is shown that the theory proposed by Trichel is applicable except as modified by the influence of the negative ion space charge and the necessity of triggering electrons. 13 Refs.

Primary Keywords: Corona; Point-plane Gap; Air Gap; Corona Pulses; Trichel Pulse; Effect Of Particles; Field Emission

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8998  
(BREAKDOWN STUDIES)  
(Liquid; Electrical)

SOME FEATURES IN THE ELECTRIC BREAKDOWN OF ELECTROLYTES

N.P. Melnikov, G.A. Ostroumov and A.A. Shteinberg  
A.A. Zhdanov Leningrad State University, Leningrad, USSR  
Soviet Physics-Doklady, Vol. 7, No. 12, pp 1102-1104 (06/1963)  
Trans. From: Doklady Akademii Nauk SSSR 147, 822-825 (December 1962)

The characteristics of a capacitor discharge in an aqueous electrolyte are studied. A capacitor is connected across a test cell by use of a trigatron gap to produce a step voltage of 15 kV across a gap of 0.25-20 mm. Several electrolytes are tested over a wide range of concentrations. Three distinct regions of concentration are found: 1) breakdown possible; 2) no breakdown with aperiodic discharge of capacitor; and 3) no breakdown with oscillatory discharge. 11 Refs.

Primary Keywords: Liquid Breakdown; Electrolyte; Three Regions Of Concentration; Several Electrolytes; Wide Range Of Concentration; Variable Gap Spacing

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8999  
(BREAKDOWN STUDIES)  
(Liquid, Electrical)  
THE DEVELOPMENT OF AN ELECTRIC DISCHARGE IN AQUEOUS ELECTROLYTES  
M.P. Melnikov, G.A. Ostrovskiy and M.Yu. Stoyak  
A.A. Zhdanov Leningrad State University, Leningrad, USSR  
Soviet Physics-Doklady, Vol. 8, No. 2, pp 176-178 (08/1963).  
Trans. From: Doklady Akademii Nauk SSSR 148, 1057-1059 (February 1963)  
Several empirical formulae are given for the breakdown of aqueous electrolytes in this paper. NaCl dissolved in water is classified into three distinct concentration (conductivity) level ranges and the breakdown properties are found to be consistent within each classification. Pulsed voltages of up to 16 kV are used to produce breakdown. 2 Refs.  
Primary Keywords: Electrolyte Breakdown; Salt Electrolyte; Glow Discharge; Brush Discharge; Statistical Sample; Empirical Formula  
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9008  
(BREAKDOWN STUDIES)  
(Surface Flashover)  
TRACKING IN POLYMERIC INSULATION  
M.J. Billings, A. Smith and R. Wilkins  
University of Manchester, Manchester, UK  
IEEE Transactions On Electrical Insulation, Vol. EI-2, No. 3, pp 131-137 (12/1967)  
Chemical mechanisms of tracking and erosion are reviewed by considering mechanisms of conduction and molecular structure of polymers. It is shown that track formation need not necessarily be by graphite formation and that degradation mechanisms cannot always be predicted by inspection of molecular stereochemistry. 25 Refs.  
Primary Keywords: Insulator Tracking; Insulator Erosion; Conduction Mechanism; Graphite Formation; Molecular Stereochemistry  
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9007  
(SWITCHES, CLOSING)  
(Vacuum Gaps, Electrical)  
RECOVERY CHARACTERISTICS OF A TRIGGERED-VACUUM GAP AT HIGH CURRENTS  
J.D. Cobine and L.E. Prescott  
General Electric Co., Schenectady, NY 12301  
Journal Of Applied Physics, Vol. 42, No. 12, pp 4865-4869 (11/1971)  
A system has been devised for use with a high-current generator whereby the recovery-strength characteristics of a triggered-vacuum gap (TVG) may be determined. Data are presented for an experimental hydrogen-triggered TVG for currents of 2000, 5000 and 10000 A; the latter value being near the upper limit of the tube studied. The causes of data scattering are discussed. 10 Refs.  
Primary Keywords: Metal Vapor; Residual Gases; Thermionic Emission; Varying Recovery Strength  
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9012  
(SWITCHES, OPENING)  
(Mechanical, Materials)  
DEVELOPMENT OF CONTACT MATERIALS FOR VACUUM INTERRUPTERS  
P. Barkan (1), J.M. Lafferty (2), T.M. Lee (1) and J.L. Lento (1)  
(1) General Electric Co., Philadelphia, PA 19153  
(2) General Electric Co., Schenectady, NY 12301  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-90, No. 1, pp 359-359 (02/1971)  
Conventional contact materials cannot simultaneously meet three of the most critical functional requirements of the high capacity vacuum interrupter. This paper describes the development of a new class of vacuum interrupter contact alloys which offer exceptional properties combining high interrupting capability, high dielectric strength, and anti-welding. The mechanism by which anti-welding is achieved is described and substantiated by test results. 41 Refs.  
Primary Keywords: Vacuum Interrupter; Several Contact Alloys; High Interrupting Capability; High Dielectric Strength; Anti-welding  
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9031  
(SWITCHES, CLOSING)  
(Vacuum Gaps, Electrical)  
INDUCTANCE AND INTERNAL RESISTANCE OF VACUUM DISK SWITCHES  
G.N. Aratov, V.I. Vosil'ev, M.I. Pergament and S.S. Iserevitsinov  
Soviet Physics-Technical Physics, Vol. 13, No. 6, pp 818-821 (12/1968).  
Trans. From: Zhurnal Tekhnicheskoy Fiziki 38, 1079-1083 (June 1968)  
Previous communications have dealt with the control and electrical strength of these switches. Here estimates are made of the inductance and internal resistance, which with the results made previously allow recommendations on the design and use. 3 Refs.  
Primary Keywords: Vacuum Disk Switch; Performance Test; Diagnostics; Inductance Measurement; Resistance Measurement; Design Considerations  
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9121  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
SPECTROSCOPIC STUDY OF THE PLASMA OF A LOW-VOLTAGE PULSE DISCHARGE IN VACUUM  
V.A. Deryavshchikov and M.A. Deryabina  
Moscow, USSR  
High Temperature, Vol. 4, No. 1, pp 16-22 (02/1966).  
Trans. From: Teplofizika Vysok Np Temperatur 4, 28-26 (January-February, 1966)  
Results of a spectroscopic study of plasma formed in a pulse discharge between solid electrodes of coaxial geometry are presented. The initial pressure in the vacuum chamber being 1E-5 to 1E-6 mm Hg. The excitation temperatures in various parts of the jet were determined by Orstein's method. The distribution of doubly-charged aluminum ions over the excited states was determined. A maximum plasma temperature was found for a certain discharge energy. The radial distribution of temperature in the anode jet was determined; the temperature rose with distance from the anode. 7 Refs.  
Primary Keywords: Vacuum Breakdown; Pulse Breakdown; Anode Jet; Coaxial Electrodes; Temperature vs Discharge Energy  
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9126  
(BREAKDOWN STUDIES; SWITCHES, OPENING; DIAGNOSTICS AND INSTRUMENTATION; DIAGNOSTICS AND INSTRUMENTATION)  
(Exploding Wires, Explosive Fuses; Current; Voltage)  
TIME RESOLVED ELECTRICAL MEASUREMENTS IN HIGH CURRENT DISCHARGES  
E.C. Cassidy, S.M. Zimmerman and K.K. Neumann  
National Bureau of Standards, Washington, DC 20234  
The Review Of Scientific Instruments, Vol. 37, No. 2, pp 210-214 (02/1966)  
A method for measurement of the resistive component of the instantaneous voltage across a sample installed in a high voltage, high current circuit is described. Simultaneous measurement of the current permitted time resolved determination of electrical energy dissipation, power, and resistance of the sample. The system was calibrated calorimetrically, and measurements were made with exploding wire samples. 14 Refs.  
Primary Keywords: Exploding Wire; Current Measurement; Voltage Measurement; Resistance Measurement; Temporal Resolution  
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9127  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
TRANSIENT CHARACTERISTICS OF RADIATION EMISSION FROM THE PLASMA OF A PULSED DISCHARGE IN VACUUM  
V.A. Deryavshchikov  
All-Union Institute, Moscow, USSR  
High Temperature, Vol. 5, No. 3, pp 380-386 (06/1967).  
Trans. From: Teplofizika Vysokikh Temperatur 5, 423-432 (May-June 1967)  
The present paper gives results of an investigation into the transient characteristics of radiation emission from the plasma of a high-current pulsed discharge between electrodes of coaxial geometry at pressures of 1E-5 - 1E-6 mm Hg in a vacuum chamber. Oscillograph recording of various spectral lines was carried out simultaneously with the fast discharge of the discharge by means of an SFM-2M photorecorder. The transient temperature distributions in the regions near the anode and cathode have been determined. 7 Refs.  
Primary Keywords: Vacuum Breakdown; Radiation Emission; Coaxial Electrodes; Spectroscopy  
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9129  
(ELECTROMAGNETIC COMPATIBILITY)  
(Lightning)  
A PORTABLE SYSTEM FOR FULL-SCALE AIRCRAFT LIGHTNING-INDUCED COUPLING TESTS  
W.G. Butters  
McDonnell Aircraft Co., St. Louis, MO 63166  
IEEE 1981 National Aerospace And Electronics Conference, pp 789 (05/1981)  
A complete test system has been developed by the McDonnell Aircraft Company, for remote site lightning testing. The system includes the modular high-voltage Marx generator, a fiber optically-coupled sensor and diagnostic system, and a computer-controlled data acquisition system. It is specifically designed to be easily packaged for shipment and readily assembled at the test site. The complete system has been used recently to perform lightning tests on the space shuttle orbiter for NASA JSC and on the USAF YF-16 aircraft for the Air Force and Navy.  
Primary Keywords: Lightning Effects; Laboratory Simulation; Marx Generator; 1.5 MV Output Voltage; Diagnostic System  
Secondary Keywords: Abstract Only  
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9139  
(ENERGY STORAGE, MECHANICAL)  
(Rotating Machines, Materials)  
HIGH CURRENT AND HIGH CURRENT DENSITY PULSE TESTS OF BRUSHES AND COLLECTORS FOR HOMOPOLAR ENERGY STORES  
R.A. Marshall  
University of Texas at Austin, Austin, TX 78712  
IEEE Transactions On Components, Hybrids, And Manufacturing Technology, Vol. CHMT-4, No. 1, pp 127-131 (03/1981).  
The incentive exists to use high collector current densities in pulsed duty homopolar generators, the current densities of interest being in the range of 15-15 MA/sq.m. Tests have been conducted in which current pulses of up to 0.25 MA with an equivalent pulsewidth of 0.3 s have been passed between pancake brush assemblies and flat plate collectors with collector current densities of up to 78 MA/sq.m. and current densities in the brush fingers of 570 MA/sq.m. The current carried per brush have been a comparatively low 800 A. These tests have been successful and are providing the data necessary for the design of the all-iron-rotating homopolar pulse generators. 8 Refs.  
Primary Keywords: Homopolar Generator; Pancake Brush Assembly; Flat-plate Collector; 78 MA/sq.m. Brush Current Density; Performance Test  
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9141  
(PARTICLE BEAMS, ION)  
(Generation)  
NEW TYPE OF PULSED ION SOURCE WITH CRYOGENIC ANODE  
K. Kasuya, K. Morioka, T. Takehashi, A. Urai and M. Hijioka  
Tokyo Institute of Technology, Nagatsuta 4259, Midori-ku, Yokohama, Japan 227  
Applied Physics Letters, Vol. 39, No. 11, pp 887-888 (12/1981).  
A magnetically insulated diode with a cryogenically refrigerated anode is proposed and a prototype of such a diode is constructed. Water ice is produced on an anode which is cooled with liquid nitrogen. A small machine, consisting of a Marx generator and a Blumlein line, is used to extract ion beams from the diode. Proton beams of about 50 A and 70 keV are obtained with good reproducibility. Diode electrical characteristics and the extracted beam performance are also examined. 3 Refs.  
Primary Keywords: Ion Diode; Magnetic Insulation; Water Ice Emitter; Liquid Nitrogen Cooled; 50 A Proton Current; 70 keV Ion Beams  
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9146  
(INSULATION, MAGNETIC)  
(C)  
STRUCTURE OF THE FRONT OF A MAGNETIC-INSULATION WAVE  
A. V. Gordeev  
Soviet Physics Technical Physics, Vol. 23, No. 8, pp 991-992 (08/1978).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki, Vol. 48, pp 1746-1748  
3 Refs.  
Primary Keywords: Coaxial Arrangement; Nonlinear TM Mode; Vacuum  
Coaxial Waveguides; Hydrodynamic Approximation  
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9158  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
ELECTRON DISTRIBUTION FUNCTION IN 4:1 N/SUB 2/-O/SUB 2/ MIXTURE  
N. I. Aleksandrov, F. I. Vyskailo, R. Sh. Islamov, I. V. Kochetov, A. P.  
Nepartovich and V. G. Pavlov  
High Temperature, Vol. 19, No. 1, pp 17-21 (02/1981).  
Trans. From: Teplofizika Vysokikh Temperatur 19, 22-27  
(January-February 1981)  
The results calculated for the electron distribution function in a  
4:1 N/sub 2/-O/sub 2/ mixture are outlined. Tables and graphs of the  
distribution function and the electronic kinetic constants are given.  
25 Refs.  
Primary Keywords: Air Breakdown; Electron Distribution Function;  
Nitrogen-Oxygen Mixture; Modeling; Ionization  
Processes; No UV Radiation; Theory  
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9200  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
QUALITATIVE STREAMER THEORY  
E. D. Lozanskii and O. B. Firsov  
Soviet Physics JETP, Vol. 29, No. 2, pp 367-369 (08/1969).  
Trans. From: Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki 56,  
670-675 (February 1969)  
A simplified calculation of streamer development is proposed,  
based on the model of an ideally conducting plasma produced on the  
boundaries by electrons moving in and out of a plasma. The main  
conclusions are that the streamer propagation velocity is  
approximately proportional to its length and the streamer thickness  
is proportional to the square root of the length; this is in good  
agreement with experiment. The plasma density and the field strength  
 $E^*$  in the streamer are also estimated. It is shown that  $E^*$  is much  
smaller than the applied field, thus confirming the assumption that  
the plasma has ideal conductivity. 5 Refs.  
Primary Keywords: Streamer Development Calculation; Ideally Conducting  
Plasma; Estimated Field Strength; Electron Cascade;  
Streamer Propagation Velocity; Plasma Density  
Calculation; Field Strength Calculation; Theory  
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9218  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
THE GLOW-DISCHARGE-TO-ARC TRANSITION INSTABILITY  
A. J. T. Holmes  
Imperial College Of Science And Technology, London, UK  
Journal Of Physics D: Applied Physics, Vol. 8, No. 6, pp 690-695  
(06/1975)  
It has been observed that the cathode fall potential of an  
anomalous glow discharge with a cold cathode has an upper limit, so  
that if a voltage pulse exceeds this limit the discharge is converted  
into a vapour arc, within less than  $10^{-7}$  s. The discharge voltage and  
current density at transition have been measured in the gas density  
range  $10^{22}$ - $10^{23}$   $\text{m}^{-3}$  in Hg vapour and in Xe, using a liquid Hg  
anode and cathode. The transition voltage is found to decrease with  
rising ambient gas density and it depends only slightly on the nature  
of the gas, whereas the transition current density rises linearly  
with gas density and is more than one order of magnitude larger in Xe  
than in Hg. The proposed theory of the instability, which allows for  
various secondary emission mechanisms and an axial gas density  
distribution in the cathode fall region, confirms the existence of a  
maximum value of the cathode fall potential. A current density  
perturbation changes the gas density distribution causing an increase  
in total secondary electron emission and current density, and leads  
to a transition to the arc. Good agreement is obtained between theory  
and observations. 6 Refs.  
Primary Keywords: Glow Discharge; Arc Discharge; Glow-to-arc  
Transition; Cathode Fall; Xenon Gas; Mercury Vapor;  
Experiment; Theory  
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9219  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Vacuum, Electrical; Electrodes; Vacuum Gaps, Materials)  
EXPERIMENTAL STUDY OF THE DYNAMICS OF CATHODE SPOTS DEVELOPMENT  
V. I. Rekhovskii  
All-Union Institute, Moscow, USSR  
IEEE Transactions On Plasma Science, Vol. PS-4, No. 2, pp 81-102  
(06/1976)  
This paper presents results of a study of cathode spot size and  
movement in a vacuum arc. The authors utilized an image converter  
camera to photographically record 16 separate frames of vacuum arcs  
for several residual gas pressures and times. Several conclusions are  
drawn regarding the variation of cathode spot size and movement. An  
extensive literature survey is included. 150 Refs.  
Primary Keywords: Vacuum Breakdown; Cathode Spot; Spot Size; Spot  
Movement; Literature Survey; Photographic  
Diagnostic; Cathode Erosion  
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9235  
(INSULATION, MATERIAL; BREAKDOWN STUDIES)  
(Solid, Surface Flashover)  
CHARGING OF INSULATOR SURFACES BY IONIZATION AND TRANSPORT IN GASES  
C. M. Cooke  
Massachusetts Institute of Technology, Cambridge, MA  
IEEE Transactions On Electrical Insulation, Vol. EI-17, No. 2, pp  
172-178 (04/1982)  
Insulator surfaces in gases collect charge when the rate of charge  
arrival exceeds the rate of conduction by the insulator from the  
surface region. The source of the collected charge may be in close  
proximity to, and hence greatly influenced by, the surface.  
Alternatively, the source may be remote so that it releases charge  
independent of the surface accumulation. For the latter arrangement,  
charge transport through the gas greatly influences where it is  
collected. Surface charging is desired in some situations, such as  
for producing images or for processing. Charging is undesirable and  
hazardous in other situations; for example, where electrical failure  
may be triggered. A third possibility makes use of surface charge  
collection as a diagnostic procedure for materials and transport  
studies. This paper is concerned with the basic production and  
accumulation of surface charges from the adjacent gas and presents  
results on the processes involved. Transport parameters of drift,  
diffusion, and space-charge effects are considered. Examples of  
charging and measured distribution under different conditions,  
including saturation effects, are analyzed. 11 Refs.  
Primary Keywords: Insulator Surface Charging; Charge Transport In  
Gases; Charge Trajectories  
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9239  
(BREAKDOWN STUDIES; INSULATION, MATERIAL; INSULATION, MATERIAL)  
(Corona, Gas; Solid)  
CORONA AND INSULATION  
M. Goldman (1) and R. S. Sigmond (2)  
(1) Lab de Physique des Decharges, Gif-sur-Yvette, France  
(2) Norwegian Institute of Technology, Trondheim-NTH, Norway  
IEEE Transactions On Electrical Insulation, Vol. EI-17, No. 2, pp  
90-105 (04/1982)  
The aim of this paper is to review our present knowledge of the  
physics of electrical coronas and their interaction with surfaces,  
with some emphasis on phenomena which seem of importance for high  
voltage insulation. We will concentrate on fundamental and general  
subjects, in order to limit the scope of the paper and to make it  
serve as an introduction to the more specialized papers that follow.  
94 Refs.  
Primary Keywords: Corona Discharge; Insulator Tracks; AC Corona; DC  
Corona; High-voltage Insulation; Theory  
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9257  
(BREAKDOWN STUDIES; DIAGNOSTICS AND INSTRUMENTATION; INSULATION,  
MATERIAL)  
(Partial Discharges; Partial Discharges; Testing)  
FUNDAMENTAL LIMITATIONS IN THE MEASUREMENT OF CORONA AND PARTIAL  
DISCHARGE  
S. A. Boggs and G. C. Stone  
Ontario Hydro Research, Toronto, Ontario, Canada  
IEEE Transactions On Electrical Insulation, Vol. EI-17, No. 2, pp  
143-150 (04/1982)  
The theoretical sensitivity of conventional partial discharge  
detectors is compared with that obtained from ultra wideband (UWB)  
(up to 1 GHz) detection systems. The comparison indicated that for  
relatively lossfree distributed systems, such as SF/sub 6/ insulated  
bus, the UWB system is up to two orders of magnitude more sensitive.  
UWB detection also embodied additional advantages such as  
facilitating the location of discharge sites and the rejection of  
external electrical noise. For discharge detection in  
plastic-insulated cables, true UWB detection is not practical because  
of frequency-dependent attenuation effects, although certain gains in  
sensitivity can be achieved with a detector bandwidth of up to 10  
MHz. 22 Refs.  
Primary Keywords: Partial Discharge Detector; Ultra Wideband Detector;  
Comparison; Discharge Site Location; Dielectric Loss  
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9270  
(DIAGNOSTICS AND INSTRUMENTATION; SWITCHES, CLOSING)  
(Current, Thyratrons)  
LOW INDUCTANCE CURRENT VIEWING RESISTORS FOR HYDROGEN THYRATRONS  
C. A. Muchenrau  
TAM Research Products Inc, Albuquerque, NM 87108  
3rd 1981 IEEE International Pulsed Power Conference, pp 167-170  
(06/1981)  
Special low inductance current viewing resistors have been  
designed and tested for use with low inductance thyratrons. The CVR's  
add less than 3 nH measurement capability. Bandwidth of these devices  
has been calculated to be DC to 300 MHz and measured to be DC to 450  
MHz. Power handling and peak current capabilities of these devices  
exceed that which can be switched by hydrogen thyratrons. Design  
methods and a brief summary of construction techniques will be  
discussed. 0 Refs.  
Primary Keywords: Current Viewing Resistors; 300 MHz Bandwidth;  
Hydrogen Thyratrons; Data Acquisition Systems;  
Passive Integrators  
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9273  
(BREAKDOWN STUDIES)  
(Corona)  
MECHANISMS FOR INCEPTION OF DC AND 60-HZ AC CORONA IN SF/SUB 6/  
R. J. Van Brunt and M. Misakian  
National Bureau of Standards, Washington, DC 20234  
IEEE Transactions On Electrical Insulation, Vol. EI-17, No. 2, pp  
106-120 (04/1982)  
Using a pulse counting technique, inceptions of positive and  
negative point plane corona in SF/sub 6/ under DC and 60-Hz AC  
conditions were measured. Effects of gas pressure, UV-radiation, and  
point electrode size on differences between AC and DC, and between  
positive and negative inceptions were investigated. Inceptions were  
also calculated using the streamer criterion. Agreement was obtained  
with measured negative inceptions for both AC and DC conditions, but  
not with positive inceptions. The growth in the active electron  
initiation volume with applied voltage was calculated and used to  
explain the observed polarity effect. The magnitude of the polarity  
effect is predictably reduced, either by irradiating the gap or by  
increasing the diameter of the point electrode. The difference  
between AC and DC positive inceptions is attributed to the  
enhancement of avalanche-initiating electron production by the  
residual ion space charge from negative corona in the previous  
half cycle. 39 Refs.  
Primary Keywords: Corona Pulses; DC Corona; AC Corona; SF/sub 6/ Gases;  
Corona Inception; Polarity Effect  
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9282  
(BREAKDOWN STUDIES)  
(Corona)

PARTICLE CHARGING IN DC CORONA FIELDS-A REVIEW

I.T. Inculat  
University of Western Ontario, London, Ontario, Canada  
IEEE Transactions On Electrical Insulation, Vol. EI-17, No. 2, pp 168-171 (04/1982).  
After a brief review of the currently accepted theory of particle charging in corona fields in air by both ionic bombardment and diffusion in the dark space surrounding the DC corona glow, the paper presents some of the recently published findings on particle charging within the corona glow. The study was made possible by the discovery that additions of CO/sub 2/ to air in a 5 to 20 percent range will increase a cylindrical positive corona glow to a size which is sufficiently large to allow particles to be dropped onto various trajectories parallel to the corona wire and their charge to be measured. The influence of the shape of the particles when exposed to corona charging is also discussed. 7 Refs.  
Primary Keywords: DC Corona; Macro-particle Charging; Charge Measurement; CO/sub 2/-Air Mixture  
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9287  
(BREAKDOWN STUDIES)  
(Gas, Electrical)

PRE-BREAKDOWN DISCHARGES IN HIGHLY NON-UNIFORM FIELDS IN RELATION TO GAS-INSULATED SYSTEMS

M. Anis and K.D. Srivastava  
University of Waterloo, Waterloo, Ontario, Canada  
IEEE Transactions On Electrical Insulation, Vol. EI-17, No. 2, pp 131-142 (04/1982).  
In clean SF/sub 6/ gas-insulated power transmission systems significant pre-breakdown discharges are rarely observed. This is so because the prevailing electric field is only moderately non-uniform. In practical systems, however, conducting particle contamination creates regions of highly non-uniform fields. Rod-to-plane gaps provide a convenient way of studying pre-breakdown discharges in SF/sub 6/ under highly non-uniform fields under controlled laboratory conditions. The relatively few published reports of investigations of pre-breakdown discharges in SF/sub 6/ are reviewed. Based on the authors' and other published experimental results, several pre-breakdown regimes (for example, single pulse and multiple pulse pre-discharges and incomplete breakdowns etc.) are identified. The randomness of the time delay of the first pre-discharge current pulse is attributed to the rate of production of initiatory electrons near the anode and the growth of electron avalanches thus generated. The importance of the spatial electric field distribution around the rod electrode (anode) is emphasized. 44 Refs.  
Primary Keywords: SF/sub 6/ Breakdown; Prebreakdown Phenomena; Highly Nonuniform Field; Several Prebreakdown Regimes  
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9288  
(BREAKDOWN STUDIES)  
(Corona)

PULSE CORONA DISCHARGE IN ELECTROSTATIC PRECIPITATORS

M.I. Milde  
Ion Physics Corp., Burlington, MA 01803  
IEEE Transactions On Electrical Insulation, Vol. EI-17, No. 2, pp 179-186 (04/1982).  
In electrostatic precipitators (ESPs) the electric field is responsible for producing ions in the vicinity of the corona wires, charging particles, and transporting charged particles to the collecting plates. In standard Cottrell-type precipitators, these functions are performed by applying a DC voltage between corona electrodes and collecting plates. Because ion production requires a high electric field strength near the cathode while particle transport is optimized in a uniform field, this arrangement is always a compromise, and sometimes a poor one. Energizing precipitators with both a DC base voltage and superimposed pulse voltage, on the other hand, provides for a separation of the functions: particle transport being performed by the DC base voltage and ion production by the pulse voltage. 21 Refs.  
Primary Keywords: Corona; Pulsed Corona; Wire Erosion; Voltage Decay; Particle Charging  
Secondary Keywords: Electrostatic Precipitator  
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9291  
(BREAKDOWN STUDIES)  
(Gas, Electrical)

PULSED GLOW DISCHARGES IN LASER EXCITATION AND BREAKDOWN

L.E. Kline  
Westinghouse Research and Development Center, Pittsburgh PA  
IEEE Transactions On Electrical Insulation, Vol. EI-17, No. 2, pp 121-124 (04/1982).  
The spatio-temporal development of discharges in uniform field gaps has been studied for many years in order to understand the physical mechanisms of breakdown. These studies have shown that a glow discharge structure is produced as an intermediate stage in the breakdown process which finally leads to the formation of a filamentary arc. Recently these pulsed or transient glow discharges have been used to pump a wide variety of gas lasers including CO/sub 2/ lasers and rare gas-halide excimer lasers. Preionization of the gas volume is usually used to "stabilize" these laser glow discharges, i.e. to increase the duration and/or energy density of the pulsed glow discharge and delay the onset of arc formation. Recent experimental work also has shown that the corona discharge which are observed in DC air-plane gaps have a glow discharge-like structure. These two types of discharges are compared and some speculations are offered about the "corona stabilization" process in point plane gaps and its relationship to arc formation in uniform field gaps. 14 Refs.  
Primary Keywords: Gas Breakdown; Pulsed Discharge; Glow Discharge; Glow to Arc Transition; Preionization; Discharge Stabilization  
Secondary Keywords: Gas Laser Pumping  
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9295  
(ELECTROMAGNETIC COMPATIBILITY)  
(Grounding And Shielding)  
RESPONSE OF A TWISTED PAIR EXCITED BY THE NONUNIFORM ELECTROMAGNETIC FIELDS OF NEARBY LOOPS

J.G. Bradenson and M. Singh  
University of Oklahoma, Norman, OK 73819  
IEEE Transactions On Electromagnetic Compatibility, Vol. EMC-24, No. 1, pp 52-58 (02/1982).  
This paper derives equations for the noise induced in a twisted pair when the pair is embedded in a nonuniform electromagnetic field of a small current loop. The derived equations are applied to calculate the noise induced in a typical 135-ohm twisted pair. In the frequency range of 10 kHz-100 MHz, the noise induced in this twisted pair is shown to be less by about 70-135 dB when compared to a similar parallel-conductor line without twist that is embedded in the same field. Included is a simplified method of applying the derived equations to the problem of finding the response of the twisted pair to distinct uncorrelated noise sources, assuming that the sources can be approximated by small current loops. 10 Refs.  
Primary Keywords: Twisted Pair; Transmission Line; Response To Electromagnetic Wave; Nonuniform Field; 135 dB Attenuation; Comparison To Nontwisted Pair  
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9298  
(ELECTROMAGNETIC COMPATIBILITY)  
(Grounding And Shielding)  
SHIELDING EFFECTIVENESS OF METALLIC HONEYCOMBS

W.A. Beruster (1) and D.C. Cheng (2)  
(1) Kaman Sciences Corp., Colorado Springs, CO 80907  
(2) University of Colorado, Boulder, CO 80309  
IEEE Transactions On Electromagnetic Compatibility, Vol. EMC-24, No. 1, pp 58-61 (02/1982).  
The shielding effectiveness (SE) of infinitely large metallic honeycombs is calculated from expressions derived by Weinstein, Mittra, and Lee for receiving and transmitting infinite parallel-plate arrays. A simple formula for the transmitted fields is presented, which is applicable for honeycomb dimensions employed in practice. 4 Refs.  
Primary Keywords: Metallic Honeycomb; Shielding Effectiveness; Infinite Array; Theory; Parallel-plate Array  
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9310  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
TOPICAL PHENOMENA OBSERVED IN A SHORT-GAP ATMOSPHERIC DISCHARGE USING ROTOR AND POST ELECTRODES

M. Sugaya (1), M. Takeshi (2), T. Yamashiki (3), T. Oikawa (1) and K. Fujii (1)  
(1) Ibaraki University, Hitachi-shi, Ibaraki, Japan  
(2) Toshiba Corp., Fuchu-shi, Tokyo, Japan  
(3) Takaoka Electric Mfg Co., Aichi, Japan  
IEEE Transactions On Electromagnetic Compatibility, Vol. EMC-24, No. 1, pp 20-25 (02/1982).  
Correlation of light emission, discharge structure, waveform of the discharge current, electrode configuration, and electromagnetic radiation is examined with the intent of obtaining an effective means for preventing electromagnetic interference (EMI) due to a short-gap discharge. The electromagnetic radiation (EMR) level resulting from a current step which, in turn, was formed by a discrete movement of a cathode spot was clearly recognized. A combination of needle rotor and needle post gave the smallest electromagnetic radiation level in the experiments. 12 Refs.  
Primary Keywords: Air Breakdown; Light Emission; Electromagnetic Radiation; Electrode Configuration; Current Waveform; Correlation Of Properties; EMI Shielding  
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9350  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
HIGH-CURRENT VACUUM ARCS: PART I. AN EXPERIMENTAL STUDY

G.R. Mitchell  
General Electric Co., Philadelphia, PA 19153  
Proceedings Of The IEEE, Vol. 117, No. 12, pp 2315-2326 (12/1970).  
In this paper an experimental study is presented on freeburning vacuum arcs with currents up to about 100 kA peak. As the current is increased it is shown that the arcing voltage continues to increase until electrode melting occurs for electrode areas equal to or exceeding 10 cm in diameter. This happens during sinusoidal current loops above 10 kA peak. Once grossly melted, high-current-density spots are formed on the anode, bright constructed high-pressure columns will develop, and the mean level of the voltage may drop, even though the current is increasing. During most short arcs involving gross melting, magnetic pumping of liquid metal is given as the main force in removing metal from the electrode surface. Methods of determining anode spot temperature are discussed and estimates range from 2730 to 3350 Deg K. Part two of this article presents the theoretical interpretations of this study. 15 Refs.  
Primary Keywords: Vacuum-arc; Anode Spot; Gross Electrode Melting; Spot Temperature; High-pressure Columns; 100 kA Peak Current; Power Line Frequency  
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9381  
(PULSE GENERATORS)  
(Line Type)  
TRANSIENTS IN HIGH-POWER MODULATORS

S. Schneider and G.W. Taylor  
ECOM, Fort Monmouth, NJ 07703  
IEEE Transactions On Electron Devices, Vol. ED-13, No. 12, pp 977 (12/1966).  
The physical size involved in the design and construction of high-power modulators introduces high inductance and stray capacitance in the circuit. Analysis shows that under normal operation any inductance between the energy source and the RF device, together with stray capacitance, produces damped oscillations after the "turn-on" and "turn-off" of the RF generator beam. Unfortunately, the need for adequate protection of the RF generator and modulator requires the introduction of an additional inductor in the circuit to limit the rate of rise of fault current. Improper placement of this inductor can also produce detrimental oscillations under fault conditions. Proper design can minimize these unwanted transients. An analysis of the circuit and the results obtained in a high-power modulator are discussed. 9 Refs.  
Primary Keywords: Fault Transient; Transient Suppression; Effect On Normal Operation; Minimization Of Effect  
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9384  
(PULSE GENERATORS)  
(Trigger)  
HIGH-VOLTAGE PULSE GENERATOR WITH RISE TIME <10 NSEC  
V.B. Lebedev and G.A. Pryanikova  
Instruments And Experimental Techniques, Vol. 21, No. 4, pp 969-970  
(08/1978)  
Trans. From: Prirody i Tekhnika Eksperimenta 4, 119-120 (July-August 1978)  
A generator of high-voltage pulses is described, based on a controlled vacuum commutator to control an electrooptical laser shutter. 4 Refs.  
Primary Keywords: Pulse Generator; 15 kV Output; 8 V Trigger; 30 pF Storage Capacitor; Vacuum Commutator  
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9385  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
STABLE STATES OF A VOLUME DISCHARGE EXCITED BY AN ELECTRON BEAM IN AR  
WITH AN SF<sub>6</sub>/SUB 6/ ADMIXTURE  
Yu.I. Bychkov, Yu.D. Korolev, G.A. Mesyats, A.P. Khuzeev and I.A. Shemyak  
Soviet Physics-Technical Physics Letters, Vol. 3, No. 11, pp 461-462  
(11/1977)  
Trans. From: Pis'ma Zhurnal Tekhnicheskoi Fiziki 3, 1121-1125 (November 1977)  
The study of volume discharges in argon with fluoride admixtures is motivated by the effort to develop lasers that are halides of noble gases as active media. The experiments reported in the present letter have been carried out to determine the range of conditions corresponding to a stable volume discharge for input energies  $W=0.1-1$  J/cm<sup>2</sup>. The discharge is excited by an electron beam with pulse length  $\tau_{\text{sub}}=6-16$  nsec and current density  $j_{\text{sub}}=1-5$  A/cm<sup>2</sup>. The area of the electrodes and the exit window of the accelerator  $55$  sq. cm., the gap  $d=1.4-2$  cm, the gas pressure  $p=1$  atm, and the SF<sub>6</sub>/sub 6/ concentration is  $(0.025-1.2)\%$ . 4 Refs.  
Primary Keywords: Volume Discharge; Argon Gas; SF<sub>6</sub>/sub 6/ Admixture; E-beam Excited Discharge; Effect Of SF<sub>6</sub>/sub 6/ Concentration  
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9387  
(BREAKDOWN STUDIES; INSULATION, MATERIAL)  
(Partial Discharges; Testing)  
PARTIAL DISCHARGE EVALUATION OF POLYETHYLENE CABLE-MATERIAL BY PHASE ANGLE AND PULSE SHAPE ANALYSIS  
H.G. Kranz  
University of Wuppertal, FRG  
IEEE Transactions On Electrical Insulation, Vol. EI-17, No. 2, pp 151-155 (04/1982)  
This paper reports on the correlation of chemical and physical degradation as a result of discharge activity and partial discharge measurements, using only real quantities. The materials investigated are LDPE and peroxide crosslinked PE. An 8-channel test arrangement, controlled by a real-time microprocessor system, has been employed for time-critical evaluation and data organization. It was concluded that the lifetime of polymeric insulating materials depends on the type of internal partial discharges as well as on space charge and conductivity distribution. Two competing mechanisms make it difficult to evaluate discharge behavior near inception voltage: (1) Concentration of discharges to eroded surface areas causes an increase in deteriorating energy, and (2) Surface charges and electron trapping cause a decrease in the field strength. A scanning electron microscope was used to correlate electrical measurements to physical deterioration. 10 Refs.  
Primary Keywords: Partial Discharge Measurement; Physical Insulation Degradation; Chemical Insulation Degradation; Polyethylene Insulation; Lifetime Prediction  
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9388  
(BREAKDOWN STUDIES; INSULATION, MATERIAL)  
(Corona; Solid)  
INTERACTION OF CORONA WITH DIELECTRIC MATERIAL UNTIL DAMAGE  
C. Mayeux (1), J. Sarlabous (1) and G. Garcia (2)  
(1) C.N.R.S. Université P. Sabatier, Toulouse, France  
(2) Lab Central des Industries Electriques, Fontenay aux Roses, France  
IEEE Transactions On Electrical Insulation, Vol. EI-17, No. 2, pp 156-162 (04/1982)  
A study of polyethylene terephthalate (PET) and polypropylene (PP) treated by corona discharge for a short time is presented. Different techniques of analysis such as inverse chromatography, infrared spectroscopy, loss tangent and electric strength were used. Working at 50 Hz with a gap of 2 mm and different gases, the analysis of the polymer after treatment has shown that a limit in the transformation of the surface may be considered. Thus a critical time is defined between a pure transformation and a degradation. This latter phase is also studied with a cross linked polyethylene (XLPE). The infrared analysis and electric strength measurements have shown the role played by the relative humidity present in air. 24 Refs.  
Primary Keywords: Corona; Plastic Insulation; Interaction; Insulation Degradation; Several Analysis Techniques; Correlation Of Physical And Electrical Degradation; Humidity Effects  
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9389  
(BREAKDOWN STUDIES)  
(Lightning)  
ANALYSIS OF LIGHTNING DATA FROM THE DMSP SATELLITE  
B.N. Turman  
Patrick AFB, Florida 32925  
Journal Of Geophysical Research, Vol. 83, No. C10, pp 5019-5024 (10/1978)  
A lightning detector, consisting of 12 silicon photodiodes, each with a field view of 700 x 700 km on the earth, has been flown on a Defense Meteorological Satellite Program satellite. Peak amplitude of the lightning flash was digitized within a range of 16 discrete levels, and the largest amplitude observed within a 1-s sample interval was recorded. Approximately 10,000 lightning flashes were analyzed. The frequency of occurrence of peak lightning power within the range 168-1610 W has been obtained. The median power level was 1610 W, and about 2% of the lightning flashes had peak powers greater than 1610 W. These data are compared to similar results from a ground-based experiment. Lightning flash rate per unit surface area on the earth was 6E-8 km<sup>-2</sup> sec but this value may be biased toward high rates by the method of selecting the data base. 7 Refs.  
Primary Keywords: Satellite Lightning Detection; Silicon Photodiode Array; Lightning Analysis; Flash Brightness; Lightning Electrical Power; Large Statistical Sample  
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9391  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
EXACT SOLUTION OF POISSON'S EQUATION FOR SPACE-CHARGE-LIMITED FLOW IN A RELATIVISTIC PLANAR DIODE  
J.E. Boers and D. Kallner  
Sandia Labs, Albuquerque, NM 87115  
Journal Of Applied Physics, Vol. 40, No. 6, pp 2409-2412 (05/1969)

Poisson's equation, governing space-charge-limited flow in a relativistic planar diode, is solved assuming the initial velocities of the accelerated particles are zero, through the use of two power series convergent in the potential range  $0 < V < 2\phi_{\text{sub}}/B/\text{c}/\text{sup } 2/Z_0$  and  $2\phi_{\text{sub}}/B/\text{c}/\text{sup } 2/Z_0 < V < \infty$ . In the region of lower potential the solution is expressed in a power series in  $U$ , a normalized potential. As  $U$  becomes small the solution reduces to the well-known Child's law. In the region of higher potential, a power series in inverse powers of  $U$  is employed. As  $U$  becomes large the solution reduces to the ultrarelativistic form obtained if  $v$ , the particle velocity, can be considered equal to the speed of light. Convergence of both series is rapid, and it is only necessary to retain a few terms to realize a high degree of accuracy. 4 Refs.  
Primary Keywords: Poisson's Equation; Convergent Power Series; Space-charge-Limited Flow; Child's Law; Theory; Numerical calculation; Ultrarelativistic Solution  
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9393  
(INSULATION, MAGNETIC)  
( )  
ONE- AND TWO-SPECIES EQUILIBRIA FOR MAGNETIC INSULATION IN CO-AXIAL GEOMETRY  
K.D. Bergeron  
Sandia Labs, Albuquerque, NM 87115  
The Physics Of Fluids, Vol. 20, No. 4, pp 688-697 (04/1977)

A cold-fluid, self-consistent model of electron and ion flow in coaxial cylindrical geometries is applied to the problem of magnetically insulated diodes. The one species, nonrelativistic problem is studied to determine in what configurations and parameter domains equilibria corresponding to magnetic insulation exist. It is proved that when the outer electrode is the cathode, equilibria always exist. For an inner cathode, whether or not equilibria exist and whether they are unique depends on whether the field is azimuthal or longitudinal and on the ratio of the radii. The two-species relativistic problem is then analyzed with the help of a computational routine which integrates the cold-fluid differential equations and searches the parameter space for the point corresponding to space charge limited emission. As the critical field is approached from above, the resulting values of ion current show an enhancement over the single species prediction by a factor which increases with voltage and with anode radius. Patterns of nonexistence of equilibria similar to those observed for the one-species, nonrelativistic case are also found. 17 Refs.  
Primary Keywords: Field Emission Diode; Magnetic Insulation; Theory; Electron Flow; Ion Flow; Cold-fluid Model; Two-species Relativistic Flow; Comparison With One-species Flow  
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9405  
(DIAGNOSTICS AND INSTRUMENTATION)  
(E-field)  
MINIATURE ELF ELECTRIC FIELD PROBE  
M. Misakian, F.R. Kottler and R.L. Kahler  
National Bureau of Standards, Washington, DC 20234  
The Review Of Scientific Instruments, Vol. 49, No. 7, pp 933-935 (07/1978)  
A miniature AC electric field probe having direct electrical connections with its battery-operated electronics is described. Because its small size introduces little field perturbation, fields generated by relatively small electrode structures in laboratory environments can readily be characterized. 10 Refs.  
Primary Keywords: E-field Probe; Small Size; Small Field Perturbations; Power Line Frequency  
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9408  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
TEMPERATURE DEPENDENCE OF THE ELECTRO-OPTIC KERR COEFFICIENT OF NITROBENZENE  
R.E. HEBNER and M. MISAKIAN  
National Bureau of Standards, Washington, DC 20234  
Journal Of Applied Physics, Vol. 50, No. 9, pp 6016-6017 (09/1979)  
The Kerr coefficient of nitrobenzene was measured over the temperature range 285-340 K. To within experimental error, the data indicate that the Kerr coefficient can be expressed as a quadratic function of reciprocal temperature. Fitting the data to this quadratic function yields an equation which can be used to correct the response of a pulse-voltage measuring system based on the Kerr effect for variations in the ambient temperature. 7 Refs.  
Primary Keywords: Kerr Cell; Kerr Coefficient Measurement; Temperature Variation; Nitrobenzene Coefficient; Empirical Function  
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9424  
(PULSE GENERATORS)  
( Marx)  
IGNITRON-SWITCHED 0.6- TO 90-KV IMPULSE GENERATOR  
E.H. Beckner and R.H. Kotoski  
Sandia Labs, Albuquerque, NM 87115  
The Review Of Scientific Instruments, Vol. 33, No. 9, pp 914-915 (09/1962)  
An ignitron-switched impulse generator has been developed, capable of providing a variable output voltage of from 0.6 to 90 kV with no circuit alterations. The generator consists of 6 capacitor stages, yielding a total energy of 5000 J at 90 kV, and is discharged with a single trigger pulse. The discharge time can be controlled to within 0.1 microsecond. 3 Refs.  
Primary Keywords: Pulse Generator; 0.6 To 90 kV Impulse Generator; 5000 J Total Energy; Single Trigger Pulse; Ignitron-switched; Low Impedance; Marx Generator  
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9429  
(ELECTROMAGNETIC FIELD GENERATION)  
(Magnetic)

CREATION OF MEGAGAUSS FIELDS BY THE METHOD OF MAGNETODYNAMIC ACCUMULATION

S.G. Alkhanov, V.G. Belan, G.I. Budker, A.I. Ivanchenko and G.N. Kichigin  
Soviet Atomic Energy, Vol. 23, No. 6, pp 1307-1311 (12/1967).  
Trans. From: Atomnaya Energiya 23, 536-541 (December 1967)

Interest in the problem of creating superstrong magnetic fields has greatly increased in recent years. Works have been published describing experiments which involve the creation of pulsed magnetic fields with high intensity and also works dealing with theoretical studies of this problem. A conference was held on megagauss fields and the possibilities of creating and using intense magnetic fields are studied in various laboratories. A method of creating a strong magnetic field has found the most widespread application. This method is based on the compression of the magnetic flux by a conducting cylindrical shell which is accelerated by external forces. If the rate of compression of the shell is greater than the rate of flux leakage, the magnetic field strength increases. The maximum strength and the characteristic time of existence of the magnetic field are determined by the mass of the shell, the maximum attainable velocity and the trapped flux, the properties of the shell material, etc. The present work gives the results of the experiments on the creation of an intense magnetic field through flux compression by a collapsing liner. 7 Refs.

Primary Keywords: Magnetic Field Generation; Flux Compression; Explosive Driver; Electrical Driver

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9430  
(BREAKDOWN STUDIES)

(Exploding Wires)  
(ELECTRICAL BREAKDOWN OF CYLINDRICAL FOILS IN AIR. III. HIGH-CURRENT EXPANDING DISCHARGE)

V.A. Burtsev, A.M. Bezoldov, V.A. Dubenskii, N.P. Egorov, M.P. Kasatkina, A.B. Prodnovov and I.V. Sheshtakov  
D.V. Efremov Institute, Leningrad, USSR  
Soviet Physics-Technical Physics, Vol. 25, No. 6, pp 697-703 (06/1980).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 50, 1216-1226 (June 1980)

Results of an experimental study are described, pertaining to electrical breakdown of cylindrical aluminum foils in air and to the expanding high-current discharge initiated by this breakdown with the geometry of an inverse longitudinal pinch. The time dependence of the plasma brightness temperature in the case of "thin" (10-6 micron) foils is characterized by an initial fast-rise phase ( $\tau_{\text{sub}}/\text{phr}$  approximately 1 microsecond) and a phase of almost constant temperature throughout the entire first current half-period ( $\tau_{\text{sub}}$  approximately 35 microseconds). The maximum plasma brightness temperature in this case reaches  $\tau_{\text{sub}}/\text{phr} \approx 3.2$  eV. Determination of the plasma column temperature averaged over the cross section from the electrical conductivity of the discharge, according to electrical measurements, and from high-speed photographs taken from the end of the chamber has confirmed that there is a quasi-steady discharge phase. 8 Refs.

Primary Keywords: Electrical Breakdown; Cylindrical Aluminum Foils; Expanding High-current Discharge; Plasma Column; 3.2 eV Maximum Plasma Brightness Temperature

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9432  
(ELECTROMAGNETIC FIELD GENERATION)  
(Magnetic)

PRODUCTION OF PULSED MAGNETIC FIELDS UP TO 700 KOE

A.K. Solke and V.V. Velyevko  
Physics Institute, Academy of Sciences of the Belorussian SSR, USSR  
Journal Of Applied Spectroscopy, Vol. 27, No. 1, pp 936-939 (07/1977).  
Trans. From: Zhurnal Prikladnoi Spektroskopii 27, 177-181 (July 1977)  
A pulsed magnetic field of high intensity is usually obtained by the discharge of a capacitor bank through a solenoid. The efficiency of this process is determined by the expression  $\epsilon_{\text{et}}/\epsilon_{\text{sub}}/b/\chi$  where  $\epsilon_{\text{et}}/\text{sub } b/\chi$  is the ratio of the energy of the magnetic field of the solenoid at the first current maximum to the energy originally stored in the capacitor bank;  $\epsilon_{\text{et}}/\text{sub } b/\chi$  is the coefficient of effectiveness of the solenoid, equal to the ratio of the energy in the magnetic field in the useful volume to the energy of all the magnetic fields of the solenoid;  $\chi_{\text{sub}}/b/\chi$  divided by  $\chi_{\text{sub}}/b/\chi$  is the ratio of the parasitic inductance of the discharge circuit to that of the solenoid;  $\chi_{\text{sub}}/b/\chi$  is the damping constant; the function  $f(\chi_{\text{sub}}/b/\chi)$  is determined by a given expression. We have developed and used extensively a pulsed solenoid, the distinguishing feature being that the coil, the discharge, the connecting lines, and the power strip are all structurally fulfilled as one whole. This allowed us to bring elements with cosinusoidal currents as close to each other as possible and thereby decrease the loop of the discharge curve, to achieve the largest values of the efficiencies under the given conditions. It was also important to assure a value of  $\epsilon_{\text{et}}/\text{sub } b/\chi$  on the order of  $10^{-2}$ , which will then yield an insignificant decrease in  $\epsilon_{\text{et}}/\text{sub } b/\chi$  due to figural. 8 Refs.

Primary Keywords: Magnetic Field Generation; Solenoid Magnetic Coil; No Flux Compression; Analysis; High Efficiency

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9450  
(ENERGY STORAGE: MECHANICAL)

(Rotating Machines, Materials)  
DESIGN OF THE LIQUID-METAL CONTACTOR IN HOMOPOLAR MACHINES

A.L. Gontchik, V.A. Dievskii and U.P. Kos'kin  
Magnetohydrodynamics, Vol. 13, No. 2, pp 238-244 (06/1977).  
Trans. From: Magnitnaya Gidrodinamika 2, 127-129 (April-June 1977)  
We consider the steady flow of liquid metal in a contact device with coaxial cylindrical electrodes. This liquid-metal contactor is assumed to be in a uniform magnetic field  $b_{\text{sub}}/b/\chi$  oriented along the z axis; the induced magnetic field has no radial and axial components. 4 Refs.

Primary Keywords: Homopolar Generator; Current Contact; Liquid Metal Brushes; Magnetic Field; Theory

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9451  
(ENERGY STORAGE: INDUCTIVE: BREAKDOWN STUDIES)

(Systems; Gas; Electrical)  
DISCHARGE OF ENERGY OF A SUPERCONDUCTING INDUCTANCE INTO A FLASH LAMP

A.I. Bertinov, V.G. Menulov and O.M. Mironov  
Soviet Physics-Technical Physics, Vol. 16, No. 7, pp 1136-1141 (07/1972)

The discharge of the energy stored in a superconducting inductance into a flash lamp is analyzed. Solutions are obtained for the discharge equation assuming linear and power-law approximations for the lamp characteristic. Equations are given for the parameters of the discharge circuit. The analysis has been verified with an IFP-200 flash lamp. The discharge is oscillatory at voltages near the lamp extinction voltage. The experimental results agree with the theory. 14 Refs.

Primary Keywords: Inductive Energy Store; Superconducting Coil; Flashlamp Load; Time Resolved Resistance

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9453  
(SWITCHES, OPENING)

(Explosive Fuses)  
EXPLOSIVE SWITCHING OF AN ELECTRIC CURRENT

E.I. Bichenkov and V.A. Lobanov  
Novosibirsk, USSR  
Journal Of Applied Mechanics And Technical Physics, Vol. 16, No. 1, pp 52-54 (02/1975)  
Trans. From: Zhurnal Prikladnaya Mekhanika i Tekhnicheskoi Fiziki 1, 66-68 (January-February 1975)

Experiments are described involving a circuit-breaker element capable of switching a current with a line density of up to 35 A/cm in a time of 5 microseconds. A suggested application for this device is explosive magnetic generators with tuned back inductance. 8 Refs.

Primary Keywords: Opening Switch; Explosive Fuse; 35 A/cm. Line Current Density; 5 Microsecond Opening Time; Inductive Store

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9461  
(ENERGY STORAGE: INDUCTIVE)

(Systems)  
INDUCTIVE ENERGY STORAGE FOR PULSED DISCHARGES

Yu.A. Anan'ev, V.M. Intuganov, V.P. Kalinin and V.V. Sergeev  
Soviet Physics-Technical Physics, Vol. 16, No. 2, pp 283-286 (08/1971).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 41, 376-380 (February 1971)  
Standard energy storage devices (capacitor banks) can be replaced by inductive storage. Details of power supplies with such devices are discussed; switching devices and switching processes are also discussed. 3 Refs.

Primary Keywords: Inductive Energy Store; Storage Coil; Switching System; Parallel Loads; Flashlamp Load; Thyristor; Explosive Fuse

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9503  
(ELECTROMAGNETIC FIELD GENERATION)

(Magnetic)  
MAGNETIC FIELD COMPRESSION BY A STRONG SHOCK WAVE

A.I. Bertinov, D.A. But and V.I. Yudas  
Moscow, USSR  
Journal Of Applied Mechanics And Technical Physics, Vol. 15, No. 3, pp 427-429 (06/1974).  
Trans. From: Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki 15, 173-175 (May-June 1974)

Compression of a magnetic field by a strong shock wave impinging on a solid wall is considered in a kinematic formulation. Variation of the magnetic field in the gap between the wall and the shock front is described by a Volterra integral equation which is solved numerically. The field distribution in gas and wall is obtained, as well as the dependence of the magnetic energy stored in them on the magnetic Reynolds number and the gas velocity in a coordinate system fixed in the shock front. Similar relations for the field and energy in the gap are also calculated. The results obtained are in good agreement with the data of other investigators. 5 Refs.

Primary Keywords: Flux Compression; Shock Wave Liner Implosion;

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9505  
(PULSE GENERATORS: SWITCHES, OPENING)

(Flux Compression; Gas Gaps; Compression)  
MAGNETOIMPLOSIVE GENERATORS FOR RAPID-RISETIME MEGAMPERE PULSES

A.I. Pylavskii, V.A. Vasyukov and A.S. Russrov  
Soviet Technical Physics Letters, Vol. 3, No. 8, pp 320-321 (08/1977).  
Trans. From: Pis'ma Zhurnal Tekhnicheskoi Fiziki 3, 789-792 (August 1977)

Recent years have seen rapid development of sources of intense current pulses that use inductive storage units in conjunction with rapid breaking of the current circuit. The most promising device for this purpose is the magnetoimplosive generator, which can produce an energy approximately  $10^7$  J with a specific energy  $(1-5) \times 10^9$  J/cm<sup>2</sup> and current  $10^7$ - $10^8$  A. The energy is delivered from the magnetoimplosive generator to the external load rapidly (in approximately  $10^{-6}$  sec) by using an explosive charge to destroy a metal foil which is part of the circuit of the magnetoimplosive generator. In this letter we report an experimental study of a switch in which a rapid increase in the resistance of a plasma channel is obtained by compression by explosion products. 4 Refs.

Primary Keywords: Flux Compression Generator; Opening Switch; Plasma Compression; Opening Mechanism

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9513  
(ELECTROMAGNETIC FIELD GENERATION)

(Magnetic)  
THE PRODUCTION OF PULSED MEGAGAUSS FIELDS BY COMPRESSION OF THE METALLIC CYLINDER IN Z-PINCH CONFIGURATION

S.G. Alkhanov, V.G. Belan, A.I. Ivanchenko, V.M. Karasjuk and G.N. Kichigin  
Institute of Nuclear Physics, Academy of Sciences of the USSR, Novosibirsk, USSR

Journal Of Scientific Instruments (Journal Of Physics E), Series 2, Vol. 1, No. 5, pp 543-545 (05/1968).

The experimental apparatus is described and the experimental results are given for the production of high magnetic fields, up to 3 MG, by flux compression with metallic shell accelerated in Z-pinch configuration. The experimental data are compared with computer calculations. 7 Refs.

Primary Keywords: Magnetic Field Generation; Flux Compression; 3 MG Field; Z-pinch; Experiment; Comparison With Theory

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9517  
(PULSE GENERATORS)  
(Pulse Forming Lines)  
A GENERATOR FOR SHAPING SINGLE HIGH-VOLTAGE NANOSECOND PULSES ACROSS AN UNMATCHED LOAD  
D.I. Proskurovskii and E.B. Yankelovich  
Institute Of Atmospheric Optics, Academy of Sciences of the USSR,  
Moscow, USSR  
Instruments And Experimental Techniques, Vol. 16, No. 5, pp 1423-1426 (10/1973).  
Trans. From: Priroda i Tekhnika Eksperimenta 4, 108-111 (September-October 1973)  
The construction of a generator is described which shapes single pulses having an amplitude of up to approximately 50 kV and a leading edge duration of approximately 2 nsec across an unmatched load. The controlled spark gap is implemented in the form of a separate element in the commutating section. For tests at a frequency of 50 Hz the service life of a gap exceeded 166 operations. 4 Refs.  
Primary Keywords: Transimpedance Line Pulser; Spark Gap; Unmatched Load; No Reflections; 50 kV Output Voltage; 2 ns Rise Time  
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9518  
(PULSE GENERATORS)  
(Current)  
A GENERATOR WHICH PRODUCES CURRENT PULSES OF UP TO 10 KA AT A VOLTAGE APPROXIMATELY 100 V  
V.P. Lebedev and V.P. Voinov  
Khar'kov State University, USSR  
Instruments And Experimental Techniques, Vol. 18, No. 4, pp 1112-1113 (08/1975).  
Trans. From: Priroda i Tekhnika Eksperimenta 4, 88-89 (July-August 1975)  
A circuit for obtaining single or continuously repetitive electrical current pulses having an amplitude of up to 10 kA and a length of approximately  $1E-5$  -  $1E-4$  sec voltage 60-450 V is described. The spark gap can withstand approximately 1E5 pulses. 3 Refs.  
Primary Keywords: Pulse Generators; 10 kA Current Pulse; 100 V Output Voltage; Single Pulse; Rep-rated; Spark Gap  
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9520  
(PULSE GENERATORS)  
(Marx)  
A MOBILE GENERATOR OF 300 KV, 10 CPS VOLTAGE PULSES  
V.S. Barantsev, I.I. Kalyetskii and R.E. Klein  
Tomsk Polytechnic Institute, Tomsk, USSR  
Instruments And Experimental Techniques, No. 2, pp 371-372 (04/1954).  
Trans. From: Priroda i Tekhnika Eksperimenta 2, 108-109 (March-April 1954)  
A generator of 300 kV voltage pulses with a repetition rate of 10 cps is described. The generator uses capacitors charged through a protected choke and decoupling inductances. The voltage pulse has an energy of 800 J. and a rise time of  $1E-7$  sec. 0 Refs.  
Primary Keywords: Marx Generator; Arked'ev Marx; 100 kV Output Voltage; 800 J Stored Energy; 10 ns Rise Time; Rep Rated; 10 Hz Repetition Rate  
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9527  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
BREAKDOWN MECHANISM OF SHORT VACUUM GAPS  
G.M. Kassirov and G.A. Masvats  
Tomsk Polytechnic Institute, Tomsk, USSR  
Soviet Physics-Technical Physics, Vol. 9, No. 8, pp 1141-1145 (02/1965).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 34, 1471-1475 (August 1964).  
From the breakdown time characteristics of vacuum gaps up to 1 mm long in the nanosecond range, and from known experimental data, a hypothesis regarding the retardation of the discharge and the process of its transition into an arc is developed. Experimental data are clearly explained within the framework of the proposition set out. 19 Refs.  
Primary Keywords: Vacuum Breakdown; Experiment; Theory; 1 mm Gap Spacing; Breakdown Mechanism  
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9528  
(SWITCHES, CLOSING)  
(Gas Gaps, Self)  
BREAKDOWN-VOLTAGE STABILITY OF GAS-FILLED SWITCHES FOR VOLTAGE PULSE GENERATOR  
E.I. Zolotarev, V.D. Mukhin, L.E. Polyanskiy and V.M. Trapeznikov  
Soviet Physics-Technical Physics, Vol. 21, No. 3, pp 340-344 (03/1976).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 46, 595-600 (March 1976)  
In many applications of voltage pulse generators the system must be highly stable against spontaneous breakdown and the pulse length and repetition period must be controlled very precisely. Suitable circuits, varying in complexity, are available for this purpose. Switches with a stable breakdown voltage permit simpler solutions. 5 Refs.  
Primary Keywords: Spark Gap; Breakdown Voltage Stabilization; 100 kV Operating Voltage; 40 kA Current; Reliability  
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9531  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)  
CONTROLLED DOUBLE-TRIGGER SPARK GAP  
S.I. Lobov and M.A. Karyuzov  
Instruments And Experimental Techniques, No. 6, pp 1133-1135 (12/1961).  
Trans. From: Priroda i Tekhnika Eksperimenta 6, 94-96 (November-December 1961)  
The double-trigger principle in spark gaps operating on the right branch of Paschen's curve provides very fast action with a high safety factor. In instruments of this type at a working voltage of 1.5 kV the testing voltage is at least 3 kV, and the lag of the main discharge behind the trigger pulse does not exceed 0.05 microseconds. The spark gap is designed for a current up to 3 kA and electric pulses of several microsecond duration. 4 Refs.  
Primary Keywords: Spark Gap Switch; Double-trigger Gap; Field Distortion Gap; 3 kV Operating Voltage; 50 ns Switching Delay; 3 kA Current  
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9534  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES; INSULATION, MATERIAL)  
(Gas, Electrical; Electrodes, Gas)  
DIELECTRIC STRENGTH OF COMPRESSED SULFUR HEXAFLUORIDE AND THE ELECTRODE MATERIAL AND SURFACE STRUCTURE  
B.A. Goryunov  
Soviet Physics-Technical Physics, Vol. 20, No. 1, pp 66-67 (07/1975).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 45, 111-114 (January 1975)  
The effects of the electrode material and the methods used to finish the electrode surfaces on the ignition voltage in compressed sulfur hexafluoride have been studied. Experiments with planar-electrodes at gas pressures up to 8 atm show that the dielectric strength is a function of the mechanical strength of the electrode metal, its melting temperature, and, in particular, the technique used to finish the electrode surface. 5 Refs.  
Primary Keywords: SF/sub 6/ Insulation; Electrical Strength; Electrode Effects; Electrode Surface  
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9568  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
TRANSITION FROM FIELD EMISSION TO A VACUUM ARC  
G.N. Fursai and G.K. Kartsev  
Leningrad State University, USSR  
Soviet Physics-Technical Physics, Vol. 14, No. 10, pp 1442-1443 (04/1970).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 39, 1917-1919 (October 1969)  
The very rapid explosive transition from the comparatively low conductivity of the vacuum gap to high conductivity limited only by the parameters of the external circuit is the decisive and irreversible moment in the development of the vacuum breakdown during the destruction of the field emitter. It was our purpose to study the time characteristics of the transition during a gradual approach to the critical stage, i.e., the 'slow' transition, and for an increased rate of the supply of energy, i.e., 'forcing' (after reaching the critical stage, the amplitude of the high voltage pulse at the specimen increased discontinuously by the specified factor). Monocrystalline tungsten points were used for the investigation. 0 Refs.  
Primary Keywords: Vacuum Breakdown; Prebreakdown Currents; Field Emission; Arc Transition  
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9582  
(SWITCHES, CLOSING; SWITCHES, CLOSING; SWITCHES, CLOSING)  
(Gas Gaps, Electrical; Gas Gaps, Self; Liquid Gaps, Electrical)  
AMPLITUDE STABILIZATION OF HIGH-VOLTAGE PULSES USING POWERFUL COMMUTATORS  
A.T. Matyushin, V.T. Matyushin, V.S. Pak, N.S. Rudenko, V.I. Tsvetkov and V.I. Smetenin  
Tomsk Polytechnic Institute, Tomsk, USSR  
Instruments And Experimental Techniques, Vol. 18, No. 2, pp 469-471 (04/1975).  
Trans. From: Priroda i Tekhnika Eksperimenta 2, 118-119 (March-April 1975)  
The characteristics of three forms of discharge gaps are examined in order to establish the possibility of creating amplitude-stable high-voltage pulses. An amplitude stability of approximately 2% or better may in fact be obtained from one pulse to another. 6 Refs.  
Primary Keywords: Spark Gap; Gas Gap; Self Trigger; Field Distortion Gap; Liquid Gap; Field Distortion Gap  
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9583  
(BREAKDOWN STUDIES)  
(Surface Flashover)  
AN INVESTIGATION OF PULSE FLASHOVER OF SOME SOLID DIELECTRICS IN VACUUM  
I.I. Kalyetskii and G.M. Kassirov  
Tomsk Polytechnic Institute, Tomsk, USSR  
Soviet Physics-Technical Physics, Vol. 9, No. 8, pp 1137-1140 (02/1965).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 34, 1471-1475 (August 1964)  
Pulse flashover of various solid insulating materials in high vacuum was investigated in the range of pulse durations 0.1-3.0 microseconds and interelectrode distances up to 20 mm. The pulse ratios were determined in this range of pulse durations. The pulse flashover voltage depended on the material of the specimens, the finish of the surface, and field inhomogeneity at the electrodes. 5 Refs.  
Primary Keywords: Surface Flashover; Vacuum Insulation; Solid Insulation; 0.1-3.0 Microsecond Pulse Durations; 20 mm Interelectrode Distances; Pulsed Vacuum Spark Gaps  
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9584  
(PARTICLE BEAMS, ELECTRON; ENERGY STORAGE, INDUCTIVE; SWITCHES, OPENING)  
(Generation; Systems; Diodes, Self)  
ANODE FOR AN ACCELERATOR WITH AN INDUCTIVE ENERGY ACCUMULATOR  
G.I. Dolgachev, P.I. Blinov and I.N. Slivkov  
Instruments And Experimental Techniques, Vol. 21, No. 1, pp 11-13 (02/1978).  
Trans. From: Priroda i Tekhnika Eksperimenta 1, 14-16 (January-February 1978)  
An analysis is made of the operation of an anode proposed by the authors for an electron-optical system with a longitudinal magnetic field, which fills the role of a current commutator and accelerating system in accelerators with inductive energy accumulators. It is shown to be possible to create an anode capable of receiving a stream of low-energy electrons without significant reflection in the accumulation mode and of emitting a beam of accelerated electrons into a gaseous volume in the acceleration mode. 4 Refs.  
Primary Keywords: E-beam Generation; Inductive Energy Store; Diode Design; Anode Development; Anode-switch Combination  
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9599  
(PULSE GENERATORS; POWER CONDITIONING; POWER CONDITIONING)  
(Systems: Saturable Reactors; Pulse Forming Lines)  
HIGH-FREQUENCY MAGNETOTHRISTOR GENERATOR OF POWERFUL NANOSECOND PULSES  
E.A. Gromov, A.N. Mashkov and V.I. Shishko  
Gorkii Polytechnic Institute, USSR  
Instruments And Experimental Techniques, Vol. 23, No. 3, pp 667-669  
(06/1980).  
Trans. From: Pribery i Tekhnika Eksperimenta 3, 118-119 (May-June 1980)  
A magnetic generator for the modulation of devices of powerful pulsed electronics and optics is described. The generator system contains a thyristor generator of the inverter type, magnetic compression units based on ferrite, and shaping line with a distributed commutator - a line segment containing a saturable magnetic substance. The repetition frequency of the rectangular output pulses is 20 kHz, the pulsed power is 1 MW, the duration is 70 nsec, the duration of the front and decay is 6 nsec, and the voltage is 3 kV. The supplying voltage is 300 V, with oil cooling. The possibility of increasing the pulsed power is discussed. 11 Refs.  
Primary Keywords: Pulse Generator; Saturable Reactor Pulse Sharpening; Pulse Forming Line; Thyristor Switch; 3 kV Output Voltage; 300 V Input Voltage; Power Multiplication; Rep Rate; 20 kHz Repetition Rate  
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9601  
(PULSE GENERATORS; POWER CONDITIONING)  
(Systems: Saturable Reactors)  
HIGH-POWER MAGNETOTHRISTOR PULSE GENERATOR  
G.P. Gordeev, N.P. Polyakov, P.P. Rumantsev, V.V. Sinenko and Yu.P. Yaruskin  
Tomsk Polytechnic Institute, Tomsk, USSR  
Instruments And Experimental Techniques, Vol. 23, No. 5, pp 1179-1181  
(10/1980).  
Trans. From: Pribery i Tekhnika Eksperimenta 5, 117-119 (September-October 1980)  
The paper describes a magnetotristor generator which forms bipolar voltage pulses of amplitude 40 kV and a leading edge of 0.4 microseconds repeated at a rate of up to 1 kHz on a 6.25-nF capacitor. 5 Refs.  
Primary Keywords: Pulse Generator; Saturable Reactor Pulse Sharpening; Thyristor Switch; Unipolar Output; Bipolar Output; Loss Analysis; 40 kV Output Voltage; Rep Rate; 1000 Hz Repetition Rate  
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9604  
(PULSE GENERATORS)  
(Linear Amplifiers)  
HIGH-VOLTAGE LINEAR PULSE AMPLIFIER  
P.A. Ekstrom, D.A. Crosby and K.B. MacAdam  
University of Kentucky, Lexington, KY 40506  
The Review Of Scientific Instruments, Vol. 51, No. 12, pp 1700-1703  
(12/1980).  
This linear amplifier employs moderate-voltage power supplies and components to generate high-voltage pulses of arbitrary shape on a microsecond time scale. A linear version of the Marx generator, it is limited to a small duty fraction, but can deliver a large multiple of its supply voltage. Its initial application was generation of specially shaped field-ionization pulses in studies of Rydberg atoms. 3 Refs.  
Primary Keywords: Pulse Amplifier; Linearized Marx Generator; Low Duty Factor; 5 kV Output Voltage  
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9606  
(PULSE GENERATORS)  
(Line Type)  
HIGH-VOLTAGE SQUARE-PULSE GENERATOR WITH ENHANCED PULSE-TOP STABILITY  
V.G. Filippov  
Instruments And Experimental Techniques, Vol. 24, No. 1, pp 125-126  
(02/1981).  
Trans. From: Pribery i Tekhnika Eksperimenta 1, 120-122 (January-February 1981)  
The paper describes a high-voltage square-pulse generator made of four connected five-section twin shaping lines, commutated by a controlled multigap discharger. The stability of the pulse top is enhanced by delaying the connection of two of the shaping lines. The voltage across the load is 400 kV, the pulse duration is 70 microseconds, and the current is up to 1.5 kA. The pulse-top irregularity was  $\leq 1\%$ . 3 Refs.  
Primary Keywords: Pulse Generator; Twin Pulse Shaping Line; Five-section Line; Four Interconnected Lines; 400 kV Output Voltage; 1 Per Cent Pulse Drop; 70 Microsecond Pulse Duration  
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9612  
(PULSE GENERATORS)  
(Trigger)  
LIGHT CONTROL-PULSE DETECTOR FOR THE CURRENT SWITCHES IN A HIGH-VOLTAGE PULSE GENERATOR  
V.M. Eliseev, N.A. Ivanov and V.P. Kondakov  
Instruments And Experimental Techniques, Vol. 23, No. 1, pp 150-153  
(02/1980).  
Trans. From: Pribery i Tekhnika Eksperimenta 1, 149-151 (January-February 1980)  
A light-pulse detector immune to interference is described for an optoelectronic control system for the effectors for changing-current switching in a pulse generator. The threshold for the light pulse is 50 lx. The permissible parameters for interfering pulses at the supply terminals are amplitude 12 V and duration 100 microseconds. The device is powered from the high-voltage circuits. 2 Refs.  
Primary Keywords: Trigger Pulse Generator; Optical Trigger; Spiral Generator; Phototransistor; Pulse Transformer; 100 kV Output Voltage; Theory; Experiment  
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9635  
(PULSE GENERATORS; SWITCHES, CLOSING; POWER CONDITIONING)  
(Systems: Thyratrons; Saturable Reactors)  
THYRATRON GENERATOR OF HIGH-POWER NANOSECOND PULSES WITH INCREASED EFFICIENCY  
V.A. Vizir', N.A. Lashuk, V.P. Orel and V.P. Shcherbinin  
Tomsk Polytechnic Institute, Tomsk, USSR  
Instruments And Experimental Techniques, Vol. 22, No. 4, pp 1046-1049  
(05/1979).  
Trans. From: Pribery i Tekhnika Eksperimenta 4, 158-160 (July-August 1979)  
A circuit of a thyatron generator for short pulses with increased efficiency and decreased commutator-current overload coefficient has been described. The generator according to this circuit using a TG11-2500/50 thyatron with a pulse power of 25 MW and a duration of 50 nsec achieves an overload coefficient of approximately 1.5, the pulse power efficiency is approximately 0.8, and the average power efficiency is approximately 0.3. 6 Refs.  
Primary Keywords: Pulse Generator; Thyatron Switch; Nonlinear Ferrite Line; Filter Capacitor; High Transfer Efficiency  
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9643  
(SWITCHES, CLOSING)  
(Mollow-cathode)  
TWO-CHAMBER HEAVY-CURRENT HIGH-VOLTAGE SWITCH  
O.G. Basalov, A.S. Knyazev, A.I. Nastyukha, P.A. Smirnov and A.M. Udovenko  
Instruments And Experimental Techniques, Vol. 18, No. 1, pp 125-126  
(02/1975).  
Trans. From: Pribery i Tekhnika Eksperimenta 1, 113-114 (January-February 1975)  
A description is given of a switch that will handle currents of about 500 kA at 1-20 kV with a length of 5-100 microseconds for the first half-cycle in the pulse and a repetition frequency of 0.1 Hz; the device works with residual gas at 3-8E-2 Torr. A study has been made of the gas composition. 5 Refs.  
Primary Keywords: Mollow Cathode Arc Switch; 20 kV Operating Voltage; 500 kA Current; Two-chamber Switch; Copper Anode  
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9649  
(BREAKDOWN STUDIES; ELECTROMAGNETIC FIELD GENERATION)  
(Exploding Wires; Magnetic)  
ELECTRICAL EXPLOSION OF THE SKIN LAYER  
V.P. Gordienko and G.A. Shnerson  
Soviet Physics Technical Physics, Vol. 9, No. 2, pp 296-297 (08/1964).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 34, 376-378 (February 1964)  
The destruction of single-turn solenoids due to the ejection of molten metal from the skin layer as it is heated by the current pulse constitutes one of the difficulties met in using such solenoids to produce rapidly increasing magnetic fields. The destruction of the solenoid takes place before plastic deformation can ensue, and occurs the more violently the faster the field rises. We have studied the 'slow explosion' of the skin layer using single-turn solenoids of Wood's alloy, when violent destruction occurs at moderate fields and on the leading edge of the current pulse; in solenoids of conventional materials (copper, steel, etc.) and at induction amplitudes of 120-150 W/cm<sup>2</sup>, this process begins after the first current maximum, other things being the same. 6 Refs.  
Primary Keywords: Magnetic Field Generation; Coil Destruction; Skin Layer Explosion; Fast-rise Fields  
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9650  
(ENERGY STORAGE, INDUCTIVE; SWITCHES, OPENING)  
(Systems: Inductive Fuses)  
ENERGY TRANSFER FROM AN INDUCTIVE STORAGE TO AN INDUCTIVE LOAD BY MEANS OF AN EXPLOSIVE CURRENT DISCONNECT  
L.S. Gerasimov, V.I. Ikryanikov and A.I. Pinchuk  
Novosibirsk, USSR  
Journal Of Applied Mechanics And Technical Physics, Vol. 16, No. 1, pp 45-46 (02/1975).  
Trans. From: Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki 1, 55-59 (January-February 1975)  
A study is made of switching of current from an inductive storage by electrical explosion of a wire shunting an inductance in conformity with a model based on surface vaporization waves. It is established that the nature of the process is determined by certain generalized dimensionless parameters of the system. The modes of most efficient transfer of energy to the load are determined. 4 Refs.  
Primary Keywords: Inductive Energy Store; Inductive Load; Opening Switch; Exploding Wire; Explosion Modeling; Efficiency Considerations  
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9651  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
EXPLOSION OF A METAL BY AN ELECTRIC CURRENT  
S.V. Lebedev  
P.N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow, USSR  
Soviet Physics JETP, Vol. 5, No. 2, pp 243-252 (09/1957).  
Trans. From: J. Exptl. Theoret. Phys. (U.S.S.R.) 32, 199-207 (February 1957)  
The destruction of metal wire at currents of 5E3 x 5E6 amp/cm<sup>2</sup> was investigated. Two different types of processes were observed: rupture of the melted wire into macroscopic fragments by surface tension forces, and explosion of the melted wire caused by changed in its volume properties. The abrupt change in the electrical conductivity of melting tungsten, molybdenum, platinum, or nickel was measured. A previous conclusion, that the energy of the metal at which its electric conductivity vanishes depends on the current density, is confirmed. 19 Refs.  
Primary Keywords: Exploding Wire; Tungsten Wire; Molybdenum Wire; Platinum Wire; 5E6 A/cm<sup>2</sup> Current Density; Conductivity Change; Several Explosion Regimes  
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9660  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES)  
(Surface Flashover; Gas, Optical)  
PHOTOINDUCED SURFACE DISCHARGE  
A.G. Badrin, V.E. Leventyuk, I.V. Podmoshenskii and P.N. Rogovtsev  
Soviet Physics-Technical Physics, Vol. 24, No. 10, pp 1181-1185  
(10/1979)  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 49, 2146-2152 (October 1979)  
The surface discharge at a dielectric surface illuminated by a xenon flashlamp is studied. The breakdown field is two orders of magnitude lower than that for a conventional surface discharge. There is a threshold irradiance below which a surface discharge does not occur. A direct relation exists between the discharge and the appearance of a vapor layer at the surface. The discharge delay time is found as a function of the irradiance and the electric field. At the threshold electric field the delay time is much longer than the light flash. Various factors which contribute to the photoinduced surface discharge are discussed. 16 Refs.  
Primary Keywords: Surface Flashover; Xenon Flashlamp Illumination; Effect On Flashover Voltage; Surface Vapor Layer; Delay Measurement  
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9675  
(BREAKDOWN STUDIES; SWITCHES, OPENING)  
(Exploding Wire; High Voltage)  
USE OF AN EXPLODING WIRE AS A CURRENT COMMUTATOR  
Yu.A. Aran'ev and V.P. Kalinin  
Instruments and Experimental Techniques, No. 5, pp 1164-1166 (10/1968).  
Trans. From: Pribery i Tekhnika Eksperimenta 4, 140-142 (September-October 1968)  
Powerful electrical discharges through a conductor are characterized by the presence of a so-called 'current pause' stemming from the large resistance of the high-pressure plasma formed upon explosion of the conductor. This phenomenon leads to the possibility of using an exploding wire (or foil) as a fast acting current commutator. Such commutators are used presently mainly for fast transmission of magnetic energy to an inductive or active load and for protection of a capacitor bank against discharge to the disrupted section of the bank. In this article we present information on the operation of a commutator which is based on an exploding wire with a comparatively long current-redistribution time, about 100 microseconds. A capacitor bank with a capacitance of 2 or 3.5 nF served as the current source in the charging inductance circuit L=0.475 mH, and the discharger acted as the switch. The currents in the charging and discharging circuits were measured by means of shunts. A powerful IFP xenon flashtube was used as the nonlinear load. A long duration of the redistribution of the currents was secured by a high resistance of the tube at the initial stage of discharge. We note that when using this system of admitting energy to the tube, the discharge in it develops in the presence of a rapidly varying voltage equal to the voltage at the commutator and determinable by the properties of both the tube and commutator. 0 Refs.  
Primary Keywords: 5  
Secondary Keywords: Exploding Wire; Opening Switch; Current Pause; 100 Microsecond Opening Time; Flashlamp Load; Copper Wire

9695  
(INSULATION, VACUUM)  
(Reviews)  
VACUUM ELECTRICAL INSULATION, PRINCIPAL PROPERTIES AND RESEARCH PROBLEMS  
I.N. Slivkov  
Power Engineering, Vol. 13, No. 1, pp 19-29 (01/1975).  
Trans. From: Izvestiya Akademii Nauk SSSR, Energetika i Transport 13, 24-36 (1975)  
The viability and desirability of vacuum insulation are discussed in this paper. The author points out that vacuum insulation can theoretically withstand voltage gradients of over 5 MV/mm, is self healing, and displays a conditioning. Areas for future work are pointed out. 13 Refs.  
Primary Keywords: Vacuum Insulation; Review; Vacuum Insulation Properties; Present Performance Limitations; Future Performance Improvement  
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9696  
(POWER CONDITIONING)  
(Saturable Reactors)  
THREE-DIMENSIONAL ANALYSIS OF THE MAGNETODYNAMIC FIELDS IN ELECTROMAGNETIC DEVICES TAKEN INTO ACCOUNT THE DYNAMIC HYSTERESIS LOOPS  
Y. Saito  
Hosai University, Tokyo, Japan  
IEEE Transactions On Magnetics, Vol. MAG-18, No. 2, pp 546-551 (03/1982)  
A new magnetic field equation exhibiting dynamic hysteresis loops is proposed. Based on this magnetic field equation, a system of two-dimensional magnetic circuit equations taken into account the dynamic hysteresis loops is derived by the method of magnetic circuits. By means of magnetic power invariant transformation, a system of two-dimensional magnetic circuit equations is transformed into a system of three-dimensional magnetic circuit equations. This system of three-dimensional magnetic circuit equations is discretized in time by a finite difference method. A system of three-dimensional magnetic circuit equations discretized in time is solved by a simple iteration method, using a relaxation parameter. As an example, a system of three-dimensional magnetic circuit equations of a simple saturable reactor is derived. Also, the numerical solutions of dynamic hysteresis loops in a saturable reactor are presented together with those of experimental results. 6 Refs.  
Primary Keywords: Saturable Reactors; Dynamic Hysteresis Loop; Theory; Numerical Calculation; Magnetic Circuit Model  
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9697  
(ELECTROMAGNETIC FIELD GENERATION; REVIEWS AND CONFERENCES)  
(Magnetic; Conferences)  
CONFERENCE ON MEGAGAUSS MAGNETIC FIELD GENERATION BY EXPLOSIVES AND RELATED EXPERIMENTS  
H. Knapfel (Ed.) and F. Herlach (Ed.)  
Publisher: European Atomic Energy Community (Euratom), Brussels (07/1966).  
This conference record contains 27 papers relating to the generation of very high magnetic fields. Explosive compression of a weak field is the chief method considered. Several papers consider the effects of these fields upon materials and the generating apparatus. There is also a brief session concerning explosive MHD generators. 279 Refs.  
Primary Keywords: Magnetic Field Generation; Flux Compression Generators; Materials Interaction; Explosive MHD Generator; Current Amplification  
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9700  
(ENERGY STORAGE, INDUCTIVE)  
(Systems)  
MATCHING OF AN INDUCTIVE ENERGY STORE AND A COIL WITH LINER WITH LIMITING OF BREAKING VOLTAGE  
E.A. Zotova, I.A. Ivanov, A.P. Lototskii and V.A. Trukhin  
Power Engineering, Vol. 16, No. 6, pp 7-11 (01/1978).  
Trans. From: Izvestiya Akademii Nauk SSSR, Energetika i Transport 16, 9-14 (1978)  
An inductive energy storage system is described for powering a metallic liner driver. The mismatch of generator and load impedances is considered quantitatively and limits are placed on that mismatch. The peak discharge voltages are calculated as a function of impedance mismatch and its effect on liner acceleration is considered. 4 Refs.  
Primary Keywords: Discharge-pulse Voltage; Inductive Energy Store; Liner Acceleration System; Peak Discharge-pulse Voltage; Limiting Parameters; Impedance Mismatch  
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9701  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
THE PHYSICS OF HIGH-VOLTAGE NANOSECOND DISCHARGES IN DENSE GASES  
L.P. Babich, I.V. Lotko and L.V. Tarasova  
Radiophysica And Quantum Electronics, Vol. 20, No. 4, pp 436-442 (04/1977).  
Trans. From: Izvestiya Vysshikh Uchebnykh Zavedenii, Radiofizika 20, 637-645 April 1977)  
The article sets forth the results of experimental investigations of nanosecond electrical discharges in air at atmospheric pressure in fields with an intensity of 1E5 V/cm. Information is obtained on voltage pulses, attained during a discharge, on the conductivity currents in the discharge gap, and on the light emission of different regions of the discharge. It is shown that electrons with energies exceeding the applied voltage are generated in accordance with the rise in the conductivity current. A conclusion is drawn with respect to the determining role of 'runaway' electrons in the development of discharges. 35 Refs.  
Primary Keywords: Gas Breakdown; Air Breakdown; Atmospheric Pressure; Voltage Measurement; Current Measurement; Light Emission Measurement; Theory; Runaway Electrons  
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9702  
(PARTICLE BEAMS, ELECTRON; SWITCHES, OPENING; ENERGY STORAGE, INDUCTIVE)  
(Generation; Explosive Fuses; Systems)  
DIRECT-ACTION ACCELERATORS WITH INDUCTIVE ENERGY STORAGE AND EXPLODING CONDUCTORS  
Yu.D. Bakulin, V.S. Dzyankov, V.P. Kovalov, A.I. Kormilitsyn, B.N. Lavrent'ev, A.V. Luchinskii and V.I. Martynov  
Instruments and Experimental Techniques, Vol. 22, No. 2, pp 325-327 (04/1979).  
Trans. From: Pribery i Tekhnika Eksperimenta 2, 34-37 (March-April 1979)  
Two generators of pulsed bremsstrahlung and electron beams are described, the IGUR-I and IGUR-II instruments, in which inductive storage devices with exploding conductors are used. At a voltage of 2.8 MV on the accelerator tube and a current of 44 kA through the tube the IGUR-I provides a bremsstrahlung dose of 110 R at a distance of 1 m from the anode, while the IGUR-II at a voltage of 3.7 MV on the tube and a current of 70 kA provides a dose of 780 R. On both instruments the half-width of the bremsstrahlung pulse is regulated in the range of 0.1-0.5 microseconds. Electron beams with an energy density of 300 J/sq.cm. are extracted from the accelerator tubes. 6 Refs.  
Primary Keywords: Field Emission Diode; Direct-action Accelerators; Exploding Wire; 300 J/sq.cm. Energy Density; High-voltage Pulse Generator; Inductive Energy Storage; Magneto-hydrodynamic Calculations; Reduced Electromagnetic Induction  
Secondary Keywords: Bremsstrahlung Radiation Generation  
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9704  
(ENERGY STORAGE, CAPACITIVE)  
(Capacitor Banks)  
EFFECT OF ELEMENT DISTRIBUTION IN A CAPACITOR BANK ON THE CURRENT PULSE IN A PULSED PLASMA INJECTOR  
N.V. Balan, M.A. Mashtylav, B.I. Panachevnyi and L.V. Shushlyapin  
Khar'kov Aviation Institute, USSR  
Soviet Physics-Technical Physics, Vol. 18, No. 6, pp 749-751 (12/1973).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 43, 1179-1183 (June 1973)  
A system of equations is derived for the operation of a pulsed plasma injector whose capacitor bank consists of distributed elements. The amplitude and length of the current pulse in the injector are analyzed as functions of the element distribution in the bank. 5 Refs.  
Primary Keywords: Distributed-element Capacitor Bank; Plasma Gun; Bank  
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9705  
(PULSE GENERATORS)  
(Line Type)  
SYSTEM FOR TWO-PULSE SUPPLY OF A LARGE STREAMER CHAMBER  
V.V. Govorov, V.A. Davidenko, B.A. Dolgoshein, V.A. Kantarev, A.M. Lebedev and S.V. Somov  
Moscow Engineering-Physics Institute, Moscow, USSR  
Instruments and Experimental Techniques, Vol. 19, No. 1, pp 32-34 (02/1976).  
Trans. From: Pribery i Tekhnika Eksperimenta 1, 32-34 (January-February 1976)  
A high-voltage circuit for supplying a streamer chamber with two pulses spaced in time is described. Two-pulse supply is used to achieve brightness separation of muon and  $\pi^+$  tracks during the recording of muon decays in the 8-m streamer chamber used on the proton synchrotron of the Institute of High-Energy Physics. 5 Refs.  
Primary Keywords: 2 Pulse Supply System; 800 kV Amplitude High-voltage Pulse; Marx VPO Generator; Track Brightness; Stabilization System  
Secondary Keywords: Streamer Chamber  
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9786  
(ENERGY STORAGE, MECHANICAL)  
(Rotating Machines, Materials)  
HIGH-CURRENT BRUSHES, PART IV: MACHINE ENVIRONMENT TESTS  
J.L. Johnson and O.S. Taylor  
Westinghouse Research and Development Center, Pittsburgh PA  
IEEE Transactions On Components, Hybrids, And Manufacturing Technology,  
Vol. CHMT-3, No. 1, pp 31-36 (03/1980).  
Brush performance has been investigated with a view to establish  
whether or not continuous very high-current density operation is  
feasible for many parallel brushes running under machine environment  
conditions. The ultimate objective is the development of  
sliding-brush contact systems for advanced powerful electrical  
machines that require large currents in order to achieve high  
efficiencies and small volumes. Using a homopolar generator designed  
for that purpose, the performance of a full complement of 92 brushes  
was evaluated under conditions that included electrical loads to 9500  
A (1.6 MA/sq.cm.) and a slip ring speed of 42 m/s. Based on test data  
presented, asymmetry in the anode and cathode brush electrical  
contact resistances and wear rates of about 2:1 were found. Under the  
maximum imposed load conditions, the anode and cathode brush  
interface contact voltage drops are 0.17 and 0.08 V, respectively.  
Typically, the highest dimensionless linear wear rate (anode brush)  
is  $< 1.7 \times 10^{-11}$ . This wear rate is about one-sixth that of  
diesel-electric locomotive motor brushes, which slide on contact  
surfaces of similar peripheral speed but with less than one-tenth the  
electrical load imposed here. The high feasibility demonstrated for  
multipole-brush high-current operation is attributed to the use of  
silver-graphite brushes (0.75 mass fraction silver), a nonair (e.g.  
humidified carbon dioxide) environment, and cooling of the brush  
holders and slip rings. 7 Refs.  
Primary Keywords: High-Current Brushes; Machine Environment  
Conditions; 1.6 MA/sq.cm. Electrical Loads; 42 m/s  
Slip Ring Speed;  $< 1.7 \times 10^{-11}$  Linear Anode Brush  
Rate; Contact Voltage Drop; 2-1 Anode and Cathode  
Brush-to-Rotor Contact Resistance

9789  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
MECHANISM FOR INTERRUPTION OF CURRENT FLOW AND PRODUCTION OF SHOCK  
WAVES IN A METAL HEATED BY HIGH-DENSITY CURRENT PULSES  
N.A. Protopopov and V.M. Kul'gachuk  
Soviet Physics-Technical Physics, Vol. 6, No. 5, pp 399-404 (11/1961).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 31, 557-564 (May 1961).  
One of the most complicated unsolved problems in the heating of a  
metal is the interruption in current flow and the relation of this  
effect to the shock waves which are observed experimentally. In the  
present work we have investigated explosions of wires characterized  
by a high rate of energy induction. In order to indicate the rate  
at which the process takes place, we may say that in the present  
experiment the duration of the first pulse (up to the first current  
interruption) varies from 2E-7 to 1.5E-6 sec while the total length  
of the explosion process (except for cases in which low voltages are  
used) is less than 4 microseconds. 8 Refs.  
Primary Keywords: Exploding Wire; Current Interruption; Shock Wave;  
Tungsten Wire; Air Environment; Glass Environment  
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9742  
(POWER TRANSMISSION)  
(Cables)  
RESISTANCE OF METALS AT HIGH CURRENT DENSITIES  
V.V. Bondarenko, I.F. Kvartskhava, A.A. Plutts and A. Chernov  
Soviet Physics-JETP, Vol. 1, No. 2, pp 221-226 (09/1955).  
Trans. From: J. Exper. Theoret. Phys. USSR 28, 191-198 (1955).  
Results are given of an investigation of the dependence of  
resistance of a few metals on current density. Comparison is made of  
experimental curves, presenting the dependence of resistance for  
copper, silver, platinum and other metals on the amount of energy  
introduced, with curves and calculations from tabulated data. For  
these metals, Ohm's law is maintained up to current densities of  
about 1E7 A/sq.cm. 7 Refs.  
Primary Keywords: High-Current Cable; Cable Resistivity; Resistivity  
vs Current; Copper; Silver; Platinum  
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PERMISSION

9748  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
THE DEVELOPMENT OF THE SPARK DISCHARGE  
T.E. Allibone and J.M. Meek  
Proceedings Of The Royal Society Of London, Vol. A166, No. A924, pp  
97-126 (05/1938).  
Pulsed gas breakdown with several electrode geometries is the  
subject of this paper. Point-plane, point-point, sphere-point, and  
sphere-plane electrode configurations are considered with both  
polarities used for each configuration. The velocity of the leader  
and main stroke are measured photographically for each case and  
reported. Multiple strokes are considered. 23 Refs.  
Primary Keywords: Gas Breakdown; Long Spark; Several Electrode  
Geometries; Point Electrode; Plane Electrode; Leader  
Velocity; Spark Velocity  
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9757  
(ELECTROMAGNETIC FIELD GENERATION; ENERGY STORAGE; PULSE GENERATORS)  
(Magnetic; Reviews; Reviews)  
A METHOD OF PRODUCING STRONG MAGNETIC FIELDS  
P.L. Kapitza  
Cavendish Laboratory, Cambridge  
Proceedings Of The Royal Society Of London, Vol. 105, No. A734, pp  
691-710 (06/1924).  
This paper provides a review of energy storage techniques known at  
this time. Capacitive, inductive, and flywheel stores are all  
discussed with the inherent limitations and practical difficulties  
pointed out. Switching problems and diagnostic systems are discussed.  
The generation of magnetic fields to 500 KG are shown to be feasible  
by using the described methods. 2 Refs.  
Primary Keywords: Energy Storage; Review; Capacitive Store; Inductive  
Store; Mechanical Store; Switch; Explosive Fuse;  
Magnetic Field Generation; Solenoid  
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9762  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
ELECTRONIC SHUTTER PHOTOGRAPHS OF EXPLODING BRIDGE WIRES  
W.A. Allen, C.H. Hendricks, E.B. Mayfield and F.M. Miller  
Michelson Lab, China Lake, CA  
The Review Of Scientific Instruments, Vol. 24, No. 1, pp 1068-1069  
(11/1953).  
The experiment reported in this note is intended to yield some  
idea of the macroscopic and microscopic phenomena associated with an  
exploding bridge wire during the first few microseconds of the event.  
8 Refs.  
Primary Keywords: Exploding Wire; Bridge Wire; Photographic  
Diagnostic; Repetitive Shutter; High Temporal  
Resolution  
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9785  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
VISUALIZATION OF CYLINDRICAL SHOCK WAVES  
F.D. Bennett and D.D. Shear  
Army Aeronaut Research and Development Command, Aberdeen Proving Ground,  
MD 21005  
The Physics Of Fluids, Vol. 2, No. 3, pp 338-339 (06/1959).  
In a previous paper a method of airfoil back-lighting is introduced  
to make visible the cylindrical shock wave formed by an exploding  
wire. The present note offers an alternative scheme which has the  
advantage of tracing the path of the shock wave over a longer  
interval of time than in the earlier method. 1 Refs.  
Primary Keywords: Exploding Wire; Shock Wave; Diagnostics; Backlit  
Wire; Long Observation Time  
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9786  
(ELECTROMAGNETIC COMPATIBILITY)  
(Hardness)  
ELECTROMAGNETIC VULNERABILITY (EMV) TESTING OF AIR LAUNCHED VEHICLES  
V. Moras  
Wright-Patterson AFB, OH  
IEEE 1981 National Aerospace And Electronics Conference, pp 688-690  
(05/1981).  
The electromagnetic environment from military emitters, worldwide,  
has increased significantly in the past two decades. It is  
anticipated there will be further increases as new high powered radar  
systems and other emitters are introduced into defense inventories.  
This paper addresses the need to consider the effect of these  
environments in the design of missile systems and the testing that is  
required to insure hardness. The new family of cruise missiles and  
tactical air launched missiles are typical of the systems where EMV  
must be a major consideration. The author also discusses operational  
environments, test facilities, instrumentation and EMV hardening. 7  
Refs.  
Primary Keywords: EMP; System Hardening; Environment Characterization;  
Test Chamber  
Secondary Keywords: Missile Systems  
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9787  
(ELECTROMAGNETIC COMPATIBILITY)  
(Lightning)  
A RECURSIVE TIME DOMAIN ANALYSIS OF DISTRIBUTED LINE GRID NETWORKS WITH  
APPLICATION TO THE LTA/EMP PROBLEM  
W.S. McCormick  
Wright State University, Dayton, OH 45435  
IEEE 1981 National Aerospace And Electronics Conference, pp 783-788  
(05/1981).  
Modeling the aircraft fuselage as a two-node, TEM, lossy  
distributed network, a recursive time domain technique is presented  
to estimate the fuselage skin-current induced by a remote lightning  
strike. The technique involves the determination of the two discrete  
nodal transfer functions followed by an application of Duhamel's  
theorem to the distributed electromagnetic excitation case. The  
Fourier transform of the induced fuselage skin-current is presented  
as a function of the azimuth and elevation angles of the incident  
plane electromagnetic lightning excitation. Reference to the PORTER  
and NOAA flight programs is made along with a discussion of future  
application areas. 2 Refs.  
Primary Keywords: Distributed Network; Modeling; Lightning Effect;  
Theory  
Secondary Keywords: Aircraft Shielding

9788  
(ELECTROMAGNETIC COMPATIBILITY)  
(Lightning)  
ASSESSMENT METHODOLOGY OF THE LIGHTNING THREAT TO ADVANCED AIRCRAFT  
R.A. Perala (1) and G.A. DuBro (2)  
(1) Electromagnetic Applications, Inc., Denver, CO  
(2) Wright-Patterson AFB, OH  
IEEE 1981 National Aerospace And Electronics Conference, pp 691-697  
(05/1981).  
One research and development area of primary interest to the  
avionics community is that of assessment methodology for lightning  
vulnerability. The work in this area is concentrated on increasing  
the general understanding of the physics of the aircraft-lightning  
interaction and on developing specific laboratory threat simulation  
testing techniques. This area has two complementary facets:  
testing/simulation and analytics. The prime objective of the  
assessment methodology activity is to provide design inputs for  
aircraft protection as well as for qualification for safety of  
flight. In this paper, recent advancements are discussed in both  
facets: testing/simulation and analytics. These advancements have been  
made possible with the incorporation of nuclear electromagnetic pulse  
technology and recent indications from measurements of natural  
lightning that suggest significantly greater electromagnetic energy  
exists in the frequency range where increased coupling efficiency of  
such energy is possible to the aircraft. 19 Refs.  
Primary Keywords: Lightning Characterization; Laboratory Simulation;  
Waveform Synthesis  
Secondary Keywords: Aircraft Hardening  
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9789

## (ELECTROMAGNETIC COMPATIBILITY)

(Grounding and Shielding)

THE NAVY F/A-18A HORNET ELECTROMAGNETIC COMPATIBILITY PROGRAM

J.R. Ketterer (1) and J.J. Fisher (2)

(1) McDonnell Aircraft Co., St. Louis, MO 63166

(2) Naval Air Systems Command, Washington, DC 20361

IEEE 1981 National Aerospace And Electronics Conference, pp 698-402

(95/1981)

The F/A-18A Hornet is a first line carrier-deployed aircraft employing advanced composite structures and state-of-the-art digital electronics including a digital fly-by-wire flight control system. Because the electromagnetic environment (EME) generated on present day carrier decks can reach field strengths over 10,000 Volts/meter at some frequencies, electromagnetic compatibility (EMC) challenges were presented. The approach to aircraft EMC design established for the F/A-18A required using the airframe as an enclosed electromagnetic (EM) shield. This shielding concept allowed equipment located within the airframe shield (e.g. equipment bays) to be designed to a less severe EM environment than equipment located outside the airframe shield (e.g. the cockpit or wheel wells). Using the airframe as an electromagnetic shield presented a significant challenge, particularly because graphite/epoxy (Gr/Ep) composites represent more than one-third of the F/A-18A surface area. Overall, this concept was found to represent the least cost, weight, and design impact both to the airframe and to the electrical or electronics equipments. 1 Refs.

Primary Keywords: RF Shielding; Design Considerations; Materials Study; Performance Testing

Secondary Keywords: Aircraft Shielding

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9790

## (SWITCHES, OPENING)

(Mechanical)

A HALF CYCLE AIR BLAST GENERATOR BREAKER FOR HIGH POWER TESTING FIELDS

K. Kriechbaum

Allgemeine Elektrizitäts-Gesellschaft, AEG-TELEFUNKEN

Hochspannungsschaltgerätefabrik, Kassel, FRG

IEEE Transactions On Power Apparatus And Systems, Vol. PAS-91, No. 3,

pp 767-752 (06/1972)

Generator breakers in high-power testing fields, the back-up breakers, have the function of safety breakers. They have to protect both the generator and the test breaker from being overstressed by a short-circuit current of undesired duration. The heavy short-circuit currents of modern generators enforce the development of generator circuit-breakers of high breaking capacities. In this paper a generator c.b. is described having a rated breaking capacity of 160 kA at a service voltage of 15.4 kV. This circuit-breaker is a half-cycle breaker capable of interrupting a symmetrical current at the first current zero passage. Due to its short minimum arcing time this breaker is suitable for synchronized breaking operations and so permits an economical testing of circuit-breakers. This testing method is also described. 7 Refs.

Primary Keywords: Circuit-breakers; High Power Testing Fields; 160 kA Breaking Capacity; 15.4 kV Service Voltage; Power Line Frequency

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9791

## (PULSE GENERATORS; ENERGY STORAGE, CAPACITIVE)

(Capacitor Banks; Capacitors)

A PULSE GENERATOR FOR SHORT MEGAVOLT PULSES WITH A RISE TIME IN THE NANOSECOND REGION

M.R. Nilsson, L. Mogberg, A. Svedberg and J. Nippie

Research Institute of National Defense, Stockholm, Sweden

Physica Scripta, Vol. 1, pp 193-196 (01/1970)

The design of a Marx-Goodiet pulse generator is described.

Circular plate capacitors are used to produce a fast-rise 20 ns duration pulse at voltages up to 1.2 MV and load impedances from 40 to 120 ohms. The diagnostics used to characterize the generator are also described. 8 Refs.

Primary Keywords: Megavolt Pulse Generator; 20 Nanosecond Voltage Pulse Duration; Circular Plate Capacitors; Center Discharge; 1.2 MV Output Voltage

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9792

## (BREAKDOWN STUDIES)

(Gas, Optical)

ELECTRICAL DISCHARGE IN NITROGEN AND SULFUR HEXAFLUORIDE IN A UNIFORM FIELD

A.S. Perlin

D.V. Efremov Institute, Leningrad, USSR

Soviet Physics-Technical Physics, Vol. 17, No. 5, pp 813-817 (11/1972)

Trans. From: Zhurnal Tekhnicheskoi Fiziki 42, 1027-1032 (May 1972)

Electrical discharges in nitrogen and sulfur hexafluoride due to photoelectric processes in a uniform field are considered for pressures  $p \geq 760$  mm Hg with gaps greater than 0.1 cm. On the basis of the experimental and theoretical data, the conditions for a change in the discharge mechanism are determined. The dependence of the critical gas density (at which the transition to a streamer mechanism takes place) on the discharge gap is also obtained. 14 Refs.

Primary Keywords: Gas Breakdown; Nitrogen; SF<sub>6</sub>/sub 6/ Uniform Field; Photoelectric Process; Discharge Mechanism

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9797

## (PULSE GENERATORS; PARTICLE BEAMS, ELECTRON)

(Line Type; Generation)

DEVELOPMENT OF 36-MEGAWATT MODULATORS FOR THE ASTRON 1000-MEGAWATT ELECTRON ACCELERATOR

V.L. Smith

Lawrence Livermore Lab, Livermore, CA 94550

IEEE Transactions On Nuclear Science, Vol. NS-9, No. 2, pp 57-67 (04/1962)

A 1000-megawatt peak-power linear electron accelerator is required for the injection of electrons into a thermonuclear fusion experimental device, called the Astron, which is now under construction at the Lawrence Radiation Laboratory in Livermore, California. The Astron will determine the feasibility of an actual power-producing fusion reactor utilizing the principles of confinement and heating of a plasma by establishing a long rotating layer of relativistic electrons. The linear electron accelerator under construction is designed to produce a pulsed electron beam with an energy of 5 MeV  $\pm$  0.5%, a pulse current of 200 amperes, with a pulse duration of 0.25 microseconds and at 60 pulses per second. The accelerator will be of the induction type utilizing large magnetic cores. Approximately 400 cores will be used and each one will contribute a minimum acceleration of 12,000 volts. The details of the design and development of a line-type modulator used for pulsing cores and capable of an output peak power of 36 megawatts will be discussed in detail. A type 6587 and type 5949A thyratron were life-tested at 32 kV, 2000 amperes, and 60 pps. Useful life in excess of 1000 hours was obtained. In addition, it was necessary to develop corona-resistant connectors for this application. Life data and final design for a small connector suitable for operation at 16-kV, 0.4-microseconds (70% amplitude points) pulses with 60-nanosecond rise time, and at 60 pps are presented. 15 Refs.

Primary Keywords: 36-megawatt Modulator; 1000-megawatt Linear Electron Accelerator; 5 MeV Pulsed Electron Beam Energy; 200 Amperes Pulse Current; .25 Microsecond Pulse Duration; Accelerating Induction Electric Field; Thermonuclear Fusion

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9799

## (BREAKDOWN STUDIES)

(Exploding Wires)

ELECTRICAL EXPLOSION OF METAL WIRES

I.F. Kvarikhtsa, A.A. Pliutko, A.A. Chernov and V.V. Bondarenko

Soviet Physics JETP, Vol. 3, No. 1, pp 40-51 (08/1956)

Trans. From: J. Exper. Theoret. Phys. USSR 30, 42-53 (January 1956)

Shadow photography and oscillograms of the current and voltage are used to investigate wires exploded by electric current. It is shown that the energy liberated in the wire at the instant of the first current pulse is sometimes less than the energy needed to evaporate the wire fully, and sometimes considerably more. Shadow photographs of the successive stages of wire explosion show a strong dispersion of the wire material after the flow of the first current pulse. A qualitative explanation is given for the basic features of the wire explosion phenomenon, taking into account the high mechanical stresses produced by heating and the radial pressures due to the magnetic field produced by the current. 20 Refs.

Primary Keywords: Exploding Wire; Voltage Measurement; Current Measurement; Photographic Diagnostic; Shadowgraphy

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9800

## (BREAKDOWN STUDIES; INSULATION, MATERIAL)

(Surface Flashover; Solid)

ELECTRON AVALANCHE AND SURFACE CHARGING ON ALUMINA INSULATORS DURING PULSED HIGH-VOLTAGE STRESS

J.P. Brainerd and D. Jensen

Sandia Lab., Albuquerque, NM 87115

Journal Of Applied Physics, Vol. 45, No. 8, pp 3260-3265 (08/1974)

This paper describes a model for insulator surface charging in high-voltage ceramic vacuum diodes. The model involves electron emission from the insulator-cathode vacuum junction followed by electron avalanches on the insulator surface which leave the well positively charged. Experiments were performed to measure (i) the triple-junction (cathode-vacuum-insulator interface) emission and its relation to the initiation of the avalanche, (ii) the dynamic current in the avalanche and (iii) the saturated surface charge resulting from the avalanche. The experimental results were interpreted by computer simulation in terms of the model and were found to be in close agreement with the predictions. 11 Refs.

Primary Keywords: Electron Avalanche; Pulsed High-voltage Stress; Insulator Surface Charging; Avalanche Current Termination; Cylindrical Vacuum Diodes; Secondary Electron Multiplication

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9801

## (INSULATION, MATERIAL; BREAKDOWN STUDIES)

(Solid, Surface Flashover)

EXPERIMENTAL OBSERVATION OF SURFACE CHARGING OF HIGH-VOLTAGE INSULATORS FOR VACUUM APPARATUS

C.H. Tourneil (1), K.D. Srivastava (2) and U.J. Woolke (3)

(1) Hydro-Quebec Institute of Research, Varennes, Quebec, Canada

(2) University of Waterloo, Waterloo, Ontario, Canada

(3) H.G. Acres, Ltd., Niagara Falls, Ontario, Canada

IEEE Transactions On Electrical Insulation, Vol. EI-7, No. 4, pp 176-179 (12/1972)

The surface of cylindrical insulators placed in high vacuum becomes positively charged when subjected to a high-voltage stress parallel to the dielectric surface. A study is made of the variation of the surface charge density as a function of the voltage applied to insulators made of alumina ceramic, nylon, Teflon, and Plexiglas. Direct and pulsed voltages were used in the experiments. 11 Refs.

Primary Keywords: Surface Charging Of Cylindrical Insulators; High Voltage Stress; Surface Charge Density Variation; Several Insulating Materials; Spatial Resolution

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9882  
(BREAKDOWN STUDIES)  
(Electrodes)

EXPLOSIVE ELECTRON EMISSION FROM COPPER POINTS  
V.M. Zhukov and G.N. Fursai  
M.A. Bonch-Bruyevich Leningrad Electrotechnical Institute Of  
Communications, Leningrad, USSR  
Soviet Physics-Technical Physics, Vol. 21, No. 9, pp 1112-1117  
(09/1976).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 46, 1910-1917 (September  
1976).

The explosive emission of copper points is studied. In many of the experiments the emission is excited in the chamber of an electron microscope. A stage of a rapid current increase followed by saturation is a general feature of the explosive emission of point cathodes. A comparatively slow current increase is also observed during the explosion of microscopic protruberances on a large point. This behavior is attributable to the different roles played by the cathode surface in explosive emission. With a point cathode the explosive-emission current is higher than the current predicted by the three-halves law. The volumes of material transported in the explosions of Cu and W are approximately the same for similar conditions. 21 Refs.

Primary Keywords: Explosive Electron Emission; Copper Point Cathodes; High Electric Field; Rapid Current Growth; Current Saturation; Three-halves Law; Poor Agreement  
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9804  
(BREAKDOWN STUDIES)  
(Exploding Wires)

HIGH-TEMPERATURE CORES IN EXPLODING WIRES

F.D. Bennett  
Army Amament Research and Development Command, Aberdeen Proving Ground,  
MD 21005

The Physics Of Fluids, Vol. 8, No. 6, pp 1106-1108 (06/1965).

Our recent studies show that the precipitous rise in resistance during the initial expansion of the wire occurs because of a radially symmetrical, inward travelling, vaporization wave which transforms the wire to a nonconducting gas. Presence of the inward travelling vaporization wave implies longer heating of the wire interior and a temperature rise with decreasing radius. An approximate theory of the expansion process allows estimates to be made of the core temperatures achievable by varying the wire and circuit parameters. The experimental production of high-temperature cores is limited at present by the occurrence of voltage breakdown at the interface between wire and ambient atmosphere. 7 Refs.

Primary Keywords: Exploding Wires; Vaporization Wave; High-Temperature Cores; Temperature Gradients; Voltage Breakdown; Theory; Core Temperature Prediction  
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9806  
(SWITCHES, CLOSING; PARTICLE BEAMS, ELECTRON)

(Mechanical; Generation)  
NANOSECOND PULSED ELECTRON SOURCE CONTROLLED WITH A MERCURY-WETTED SWITCH

T. Yamamoto and M. Kawanishi  
Memoirs Of The Institute Of Scientific And Industrial Research, Osaka Univ., 30, pp 91-96 (01/1973).

The authors present a method of 1 ns duration E-beam generation utilizing no exotic pulse shaping or energy storage techniques. The voltage pulse is produced by discharging a coaxial line through a mercury-wetted, hydrogen-filled relay. The resulting beam is a 70 keV, 240 nA, 1 ns duration E-beam. 3 Refs.

Primary Keywords: E-beam Generation; Mercury-wetted Switch; Electron Gun Grid; 70 keV Pulsed Electron Beam; Coaxial Cable; 240 nA Current  
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9807  
(SWITCHES, CLOSING; PARTICLE BEAMS, ELECTRON)

(Mechanical; Generation)  
NANOSECOND PULSED ELECTRON SOURCE WITH DOUBLE PULSE CONTROL

T. Yamamoto, S. Takeda and M. Kawanishi  
Osaka University, Suita, Osaka, Japan  
The Review Of Scientific Instruments, Vol. 44, No. 4, pp 571-572  
(04/1974).

A nanosecond pulsed electron beam is obtained by controlling the grid of the electron gun with sequential positive and negative pulses. Two mercury-wetted switches are operated to generate the double pulse. The resulting beam has a 100 keV, 1 nsec pulsed beam of the order of 1 A with 1 nsec time duration. 3 Refs.

Primary Keywords: E-beam Generation; Double Pulse Control; 100 keV Pulsed Electron Beam; 1 nsec Time Duration; Electron Gun Grid; Coaxial Cable; 1 A Current  
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9810  
(BREAKDOWN STUDIES)

(Gas, Electrical)  
ON THE EARLY STAGES OF ELECTRIC SPARKS

E.O. Lawrence and F.G. Dunnington  
University Of California, CA  
Physical Review, Vol. 35, pp 396-407 (02/1930).

With the Kerr-cell electro-optical shutter of Abraham-Lemoin and Beams, phenomena in the early stages of sparks between electrodes of Zn, Cd and Mg have been studied. It was found that during 50E-8 sec after beginning of the sparks, the spark doublet lines of Zn have widths of 45A, while the corresponding lines of Cd and Mg are about 30A in width. The luminosity of the metallic vapors of Zn, Cd and Mg was observed to spread from the electrodes with speeds of 2.1E5 cm/sec, 1.5E5 cm/sec, and 1.2E5 cm/sec, respectively. Photographs of the early stages of single sparks with exposure times as short as 4E-8 sec were obtained. The anaphots showed that during these short intervals of time after beginning of a spark the discharge is confined to a filament having a cross-section at the anode of 5E-4 sq. cm. which broadens out to four times this size at the cathode. From the circuit constants and these dimensions of the discharge it was accordingly estimated that the discharge current density attained the magnitude of 1.7E6 amp/sq. cm. The asymmetry of the photographed images of the sparks disappeared when the exposure times were extended to include a complete cycle of the discharge, thereby proving the satisfactory operation of the shutter. 19 Refs.

Primary Keywords: Gas Breakdown; Zinc Electrodes; Cadmium Electrodes; Magnesium Electrodes; Spectroscopic Diagnostic; Streamer Propagation Velocity; Streamer Cross Section  
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9822  
(BREAKDOWN STUDIES)  
(Surface Flashover)

THE FLASHOVER VOLTAGE OF POLYMETHYLMETHACRYLATE IN VACUUM UNDER DIRECT, ALTERNATING, AND SURGE VOLTAGES OF VARIOUS FRONT DURATIONS  
S. Grzybowski, E. Kuffel and J.P.C. McMath  
University of Manitoba, Winnipeg, Manitoba, Canada  
IEEE Transactions On Electrical Insulation, Vol. EI-7, No. 4, pp 180-185 (12/1972).

This paper presents results on flashover voltages across insulation surfaces and on the rate of surface deterioration in a vacuum of 1E-5 Torr under direct, alternating, and surge voltages of front duration in the range from 1-600 microseconds. The insulation material used was polymethylmethacrylate (PMMA) of cylindrical shape fitted between uniform field electrodes. The measurements were carried out on insulator specimens 25 mm in diameter and 5, 10, and 20 mm in length. 15 Refs.

Primary Keywords: Surface Flashover; 1E-5 Torr Vacuum; Direct, Alternating, And Surge Voltages; 1-600 Microsecond Front Duration; Organic Insulation Materials; Voltage Measurement  
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9826  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES)

(Gas, Electrical; Electrodes)  
AN EXTENSION OF THE RAMSAUER-TOWNSEND EXPERIMENT IN A XENON THYRATRON

G.A. Woolsey  
University of New England, Armidale, NSW, Australia  
American Journal Of Physics, Vol. 39, pp 558-560 (05/1971).

Ramsauer-Townsend effects in xenon are observed. Differences in calculated and experimentally obtained data are shown to be a function of contact potential and electron emission energy. This series of tests improves the accuracy of earlier experiments done by Kukolich. 5 Refs.

Primary Keywords: Ramsauer-Townsend Experiment; Contact Potential; Electron Energy Distribution; Elastic Collision  
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9827  
(PULSE GENERATORS)

(Capacitive)  
A RELIABLE 60KV FLASHLAMP TRIGGERING SYSTEM

R.E.W. Pettifer, R.G. Flavell and G.A. Robinson  
The Meteorological Office, London Road, Bracknell, Berks  
Journal Of Physics E: Scientific Instruments, Vol. 8, pp 875-877  
(05/1971).

The unit described is an external high voltage parallel triggering system capable of operation at high repetition rates. It is controlled by a 3.5 v logic-compatible pulse and delivers a 60 kV pulse to a pair of laser flashlamps. The problem of applying such pulses to the flashlamps without current leakage to the laser cavity has been dealt with in a novel way. 1 Refs.

Primary Keywords: Transformer; Output; Thyatron Switch; High Voltage Trigger Transformer  
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9866  
(SWITCHES, CLOSING)

(Gas Gaps, Electrical)  
HIGH POWER SPARK GAP SWITCHES-A NUMERICAL MODEL AND EXPERIMENTAL INVESTIGATION

J.F. Driscoll (1), R.E. Hackl (1) and J. Ponsenby (2)  
(1) University of Michigan, Ann Arbor, MI  
(2) Naval Surface Weapons Center, Silver Spring, MD 20910  
AIAA Conference On The Future Of Aerospace Power Systems, pp 1-6  
(03/1977).

This paper concentrates on optimization of spark gap parameters in the laboratory and by numerical simulation. A self-triggered, 100 ps rep-rated gap is simulated and tested while varying gas flow rate, gas type, gas pressure, current waveshape, charge transfer, and gap geometry. An optimum configuration is found and rules are presented for optimization. 13 Refs.

Primary Keywords: Spark Gap Optimization; Rep-rated; Recovery Time; Parameter Variation; High Average Power Transfer  
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9867  
(REVIEWS AND CONFERENCES; INSULATION)

(Conferences; Conferences)  
IEEE 1981 CONFERENCE ON ELECTRICAL INSULATION AND DIELECTRIC PHENOMENA (10/1981).

This conference record contains 71 papers (13 include only abstracts) concerning basic insulation phenomena, insulation conductivity, corona, and failure modes. Other sessions pertain to charge storage and transport, dielectric breakdown, composite structures, and surface flashover; a poster session deals with polymer morphology and measurement techniques. A special one-day symposium on 'Corona and Nonspark Discharges' has been incorporated into this year's Conference. This symposium consists of invited papers that will be published in the April 1982 issue of the IEEE Transactions on Electrical Insulation. 451 Refs.

Primary Keywords: Electrical Insulation; Insulation Charging; Insulation Conductivity; Insulation Breakdown; Surface Flashover; Corona  
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9868  
(REVIEWS AND CONFERENCES; BREAKDOWN STUDIES; INSULATION)

(Conferences; Conferences; Conferences)  
1981 IEEE 7TH INTERNATIONAL CONFERENCE ON CONDUCTION AND BREAKDOWN IN DIELECTRIC LIQUIDS

M.F. Schmidt (Ed.)  
(07/1981).

This conference record contains 90 papers relating to conduction and breakdown of liquid dielectrics. The topics of the papers presented range from fundamental studies on generation, transport and properties of the application of insulating oils in electrical equipment. Some contributions from adjacent fields which relate directly to the main theme are also included. This conference is very relevant to both liquid insulation and liquid switching. 729 Refs.

Primary Keywords: Liquid Breakdown; Insulation Conductivity; Charge Transport; Photoconductivity; Liquid-solid Interface; Gas Bubble Effects  
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9918  
(REVIEWS AND CONFERENCES)  
(Conferences) STM INTERNATIONAL CONFERENCE ON GAS DISCHARGES

(09/1978).

This conference record contains 91 papers concerning basic breakdown phenomena, circuit breaker operation, insulation systems, lightning research, spark gaps, and even laser aided chemical analysis. Many of the included papers present a fresh approach to previously investigated problems. 811 Refs.  
Primary Keywords: Conference; Breakdown Mechanism; Circuit Breaker; Insulation; Spark Gap; Laser Breakdown  
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9919  
(BREAKDOWN STUDIES)  
(Gas, Electrical)

EXPERIMENTAL INVESTIGATION OF STREAMER DISCHARGE DEVELOPMENT IN NEON  
V.A. Devidenko, B.A. Dolgosheln and S.V. Somov  
Moscow Engineering Physics Institute, Moscow, USSR  
Soviet Physics JETP, Vol. 28, No. 2, pp 227-230 (02/1969).  
Trans. From: Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki 55, 435-442 (August 1968)

An image converter has been used to study the development of an electrical discharge in pure neon and in neon with a molecular impurity. We have measured the rate of development of direct and reverse streamers as a function of the electric field strength and streamer length. Possible mechanisms of photoionization of the gas are discussed. 20 Refs.

Primary Keywords: Mechanisms Of Gas Photoionization; Streamer Breakdown; Neon Gas; Discharge Velocity; Particle Track Originated Discharge  
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9920  
(BREAKDOWN STUDIES)  
(Surface Flashover)

INVESTIGATION OF THE PULSED BREAKDOWN MECHANISM AT THE SURFACE OF A DIELECTRIC IN A VACUUM I. UNIFORM FIELD  
S.P. Bugaev, A.M. Tsaid'inski and G.A. Masvat  
Tomsk Polytechnic Institute, Tomsk, USSR  
Soviet Physics-Technical Physics, Vol. 12, No. 10, pp 1358-1362 (04/1968).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 37, 1855-1860 (October 1967)  
Experimental data are presented which were obtained in an investigation of luminous phenomena at, and in front of, a dielectric in pulsed breakdown along its surface in the nanosecond time range. The luminosity propagation rate along the dielectric was 2.7E7 cm/sec for a field of 137 kV/cm, and the prebreakdown current reached several amperes. A statistical study was made of the discharge delay time for pulsed breakdown. It was shown that the discharge was initiated by individual electrons and may have developed in a layer of gas adsorbed on the surface of the dielectric. 6 Refs.

Primary Keywords: Surface Flashover; Uniform Field Breakdown; Dielectric; Pulsed Breakdown; 2.7E7 cm/sec  
Luminosity Propagation Rate; 40 kV Voltage Pulse  
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9921  
(INSULATION, MATERIAL)  
(Solid)

THE APPLICATION OF WEIBULL STATISTICS TO INSULATION AGING TESTS  
G.C. Stone (1) and J.F. Lawless (2)  
(1) Ontario Hydro Research, Toronto, Ontario, Canada  
(2) University of Waterloo, Waterloo, Ontario, Canada  
IEEE Transactions On Electrical Insulation, Vol. EI-14, No. 5, pp 233-239 (10/1979).

The results of accelerated aging tests on solid electrical insulation are difficult to evaluate objectively, primarily due to the inherently large variability of the test data. This variability is often represented by the Weibull or other extreme-value probability distributions. This paper demonstrates an hypothesis test procedure which permits the objective and unambiguous evaluation of comparative dielectric tests on two different sets of data. The computation techniques are facilitated through the use of a FORTRAN computer program. A significant difference must be established at low probabilities of failure. Analysis of typical aging tests from the literature indicate that many experiments performed to date may not be statistically significant at utilization levels. The number of tests required to achieve unambiguous significance at low probability levels may render meaningful accelerated aging tests uneconomic. 4 Refs.

Primary Keywords: Electrical Insulation Aging Tests; Weibull Statistics; Constant-stress Test; Stepped-stress Test; Correlation With Normal Aging  
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9922  
(BREAKDOWN STUDIES)  
(Lightning)

LIGHTNING: VOLUME I. PHYSICS OF LIGHTNING  
R.M. Golde (Ed.)  
Publisher: Academic Press Inc. (01/1977).

Many researchers are now studying lightning phenomena. To assist students and researchers in this field, R. Golde has gathered the works of several authors together in one volume to present a history of the study of lightning and to give a comprehensive tutorial on the physics of lightning. Such topics as the physics of electrical breakdown, the charging process, lightning diagnosis, and lightning simulation are covered in detail. 1811 Refs.

Primary Keywords: Lightning; History; Lightning Physics; Electrical Discharge; Lightning Diagnostics; Lightning Simulation; Cloud Discharge; Ground Strike  
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9981  
(PULSE GENERATORS)  
(Trigger)

'CROWBAR' TRIGGERING METHOD FOR HIGH POWER PULSE CIRCUITS  
M.A. Levine, L.S. Combes and C.C. Gallagher  
AFRL, Bedford, MA 01730  
The Review Of Scientific Instruments, Vol. 32, No. 9, pp 1054-1055 (09/1961).

In dealing with high power pulse circuits required in plasma research with energies on the order of hundreds and thousands of joules being transferred in times on the order of a microsecond, the problems of timing are complicated by large voltage pickups. Of particular concern has been the development of a so-called 'crowbar' triggering pulse. A crowbar switch or circuit is designed to short out a large capacitor at the instant it is delivering maximum current and the potential difference across it is zero. This prevents the energy from being re-stored in the capacitor. An ideal method of generating a pulse to trigger a crowbar circuit and of delaying it through specific and controllable times has been developed utilizing the breakdown characteristics of a high voltage spark gap. A spark gap with an overvoltage of only 2X will break down in about 1 microsecond with faster breakdown at higher voltage. 1 Refs.

Primary Keywords: High Power Pulse Circuits; Trigger Circuit; Crowbar Circuit; Low Jitter; Noise Immunity  
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9987  
(ELECTROMAGNETIC FIELD GENERATION: PULSE GENERATORS)  
(Magnetic; Flux Compression)

GENERATION OF MEGAGAUSS MAGNETIC FIELDS USING A LINER COMPRESSED BY HIGH-PRESSURE GAS  
E.P. Velikhov, A.A. Vadenov, A.D. Bogdanets, V.S. Golubev, E.G. Kasherskii, A.A. Kiselev, F.G. Rutberg and V.V. Chernukha  
Soviet Physics-Technical Physics, Vol. 18, No. 2, pp 274-279 (08/1973).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 43, 429-438 (February 1973).  
The design of a device for generating pulsed megagauss fields in a large volume is described. The magnetic field is amplified by adiabatic compression in a cylindrical metal shell imploded by high-pressure gas (1-2E3 atm). The design energy in the compressed magnetic field is several megajoules and the lifetime is tens of microseconds. Unlike devices that use explosives, the present device is not destroyed. Unlike devices that use the energy of an electromagnetic field to compress a liner, the problem of storing and switching very large amounts of electromagnetic energy does not arise. 18 Refs.

Primary Keywords: Flux Compression; Megagauss Magnetic Field Generation; High Pressure Gas Adiabatic Compression; Efficient Energy Transfer  
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9988  
(SWITCHES, CLOSING)  
(Gas Gaps, Electrical)

LOW-INDUCTANCE 100 KV SWITCH (SPARK GAP) FOR STARTING, DIVERTING AND CLAMPING CAPACITOR DISCHARGES  
A.E. Bishop and G.D. Edmonds

Culham Lab, Abingdon, Oxfordshire, UK  
Proceedings Of The IEE, Vol. 113, No. 9, pp 1549-1556 (09/1966).  
The authors describe a field distortion switch designed to operate reliably to 100 kV voltage. Operating in a cascade mode, the switch can be triggered with such reliability to allow operation as a crowbar switch either at zero current or at maximum current. The design and testing of the switch is considered in some detail. 4 Refs.

Primary Keywords: Spark Gap; Clamping Capacitor Discharges; Field-distortion Switch; 25 ns Minimum Breakdown Time; Divert-switch; Clamp-switch; >200 kA Currents; 20-100 kV Voltage Range  
COPYRIGHT: 1966 IEE

9997  
(SWITCHES, OPENING)  
(Mechanical)

SWITCHING IN VACUUM: A REVIEW

A. Selzer  
Culter-Hammer Inc., Deer Park, NY  
IEEE Spectrum, pp 24-36 (06/1971).  
No growing use of vacuum interruption devices by the power and control industries in the past decade has introduced these mechanisms to many people to whom the area of vacuum switching is somewhat new. It is felt that a review of vacuum switching from a historical and technological standpoint will facilitate a more general understanding of this important subject. 24 Refs.

Primary Keywords: Vacuum Interruption Devices; Vacuum Technology; Electric Discharge; Historical Review  
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10002  
(BREAKDOWN STUDIES)  
(Liquid, Electrical)

VARIATIONS IN THE RESISTANCE OF SPARK GAPS IN WATER UNDER THE EFFECT OF HIGH PULSE VOLTAGE

I.I. Kalyatskiy, G.S. Korshunov and G.A. Kiselev  
Academy of Sciences of the USSR, Tomsk, USSR  
Applied Electrical Phenomena, No. 6, pp 28-31 (12/1971).  
Trans. From: Elektronnaya Obrabotka Materialov 6, 32-36 (1971)

The authors study the resistance of a water spark in the context of electrical discharge machining. The resistance of the spark is measured as a function of pulse shape, geometry, gap length, and initial water resistivity. A large prebreakdown current is found. 3 Refs.

Primary Keywords: Liquid Spark Gap; Spark Gap Resistance; High Pulse Voltage; Electric Field Configuration; Spark Gap Length; Initial Voltage Pulse Parameters  
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10003  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
GAS-HEATING EFFECT ON PLASMA RESISTIVITY  
J.E. Creighton and S. Schneider  
ECOM, Fort Monmouth, NJ 07703  
Journal Of Applied Physics, Vol. 40, No. 13, pp 5212-5216 (12/1969).  
Measurements of hydrogen-plasma resistivity were made under conditions where the dominant loss mechanism was electron-neutral collisions. Three-inch-diameter tubes with electrode spacings ranging from 2-22 in. were used. Measurements were made at 15 and 22 kA, 56-microsecond pulse duration, and pressures of 0.5, 1.0, and 5.0 Torr. Electron-density and temperature measurements were obtained from Stark-broadening and line-intensity-ratio techniques. The predicted resistivity was calculated from electron-proton and electron-neutral collisions and compared with the absolute resistivity calculated from the voltage-current measurements. The gas-temperature rise was determined from the resistance difference obtained from the two calculations. The energy expended in gas heating was determined to be 2.4%-4.2% of the input energy. 10 Refs.  
Primary Keywords: Hydrogen Discharge; Plasma Resistivity; Neutral Gas Heating; Electron-neutral Collision; Energy Balance  
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10004  
(BREAKDOWN STUDIES)  
(Lightning)  
LIGHTNING: VOLUME II. LIGHTNING PROTECTION  
R.M. Golde (Ed.)  
Publisher: Academic Press Inc. Ltd. (01/1977).  
Lightning protection is a necessary part of ensuring safety of personnel, equipment, and structures in all parts of the world. Threat-level determination, lightning detection, and lightning stroke diversion effectiveness are all addressed in this book. The book begins with a thorough discussion of the development of lightning early warning systems and proceeds to discuss the effects on humans, flora, electronic equipment, structures, and aircraft. A chapter is included on grounding. 510 Refs.  
Primary Keywords: Lightning Protection; Lightning Effects; Lightning Prediction; Lightning Diversion; Lightning Prevention  
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10005  
(POWER CONDITIONING)  
(Pulse Transformers)  
A PULSE TRANSFORMER FOR LARGE WIRE SPARK CHAMBERS  
L. Andersson, E. Radermacher and C. Rubbia  
CERN, Geneva, Switzerland  
Nuclear Instruments And Methods, Vol. 75, No. 2, pp 341-343 (11/1969).  
It is remarked that by interposing a step-down transformer between the high-voltage generator and wire spark chambers, the pulsing of the larger size chambers can be eased considerably. A simple transformer made solely of coaxial cables has been built and tested. 5 Refs.  
Primary Keywords: Stacked Line Transformer; Large Wire Spark Chambers; Coaxial Cable Pulse Transformer; 2.0 Ohm Chamber Impedance; 5.0 kV Peak Pulse Voltage; 1.25E7 W Peak Transformer Power  
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10007  
(PULSE GENERATORS)  
(Stripline)  
A SIMPLE STRIPLINE PULSER FOR SPARK CHAMBERS  
M.R. Howells, P.E. Osmon and A.G. Sheldon  
Westfield College, London, UK  
Nuclear Instruments And Methods, Vol. 79, No. 2, pp 325-328 (05/1970).  
A spark chamber pulser has been constructed using a stripline as both feeder cable and storage capacitor. The inductance of the unit is thereby minimized in a simple and inexpensive way and a pulse rise time of 10 ns into a 1000 pF load is achieved. 0 Refs.  
Primary Keywords: Spark Chamber Pulser; 10 ns Pulse Rise Time; 1000 pF Load; Low Inductance Layout; Stripline Energy Store  
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10009  
(POWER CONDITIONING)  
(Pulse Inverters)  
A TRANSMISSION-LINE PULSE INVERTER  
R.W. Rochelle  
Naval Research Lab, Washington, DC 20375  
The Review Of Scientific Instruments, Vol. 23, No. 6, pp 298-300 (05/1952).  
The polarity of fast rise-time pulses can be inverted with a minimum of distortion by means of a transmission-line network. The features in the design of a typical pulse inverter for obtaining push-pull cathode-ray-tube deflection voltages from single-ended signals are presented. The normalized design graphs are a considerable aid in the calculation of pulse-inverter characteristics. 0 Refs.  
Primary Keywords: Pulse Polarity Inverter; Fast Rise-time Pulses; Transmission-line Network; Polarity Switching; Shield Impedance; Design Considerations  
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10013  
(POWER CONDITIONING; POWER CONDITIONING)  
(Pulse Transformers, Materials; Saturable Reactors, Materials)  
EDDY-CURRENT-LIMITED GROWTH OF FERROMAGNETIC DOMAINS ON THE SURFACE OF SQUARE-LOOP ALLOY TAPES  
J.E.L. Bishop  
University of Sheffield, Sheffield, UK  
Journal Of Physics D: Applied Physics, Vol. 9, No. 14, pp 2095-2110 (10/1976).  
The expansion of small, initially hemicylindrical domains on the surface of square-loop alloy tapes has been simulated numerically under conditions of (i) constant drive field  $H_{sub} A/$  and (ii) constant flux-reversal rate  $\phi$  dot. The calculations treat each element of domain wall as being individually in dynamic equilibrium under the pressure of the applied and local eddy-current magnetic fields and the domain wall surface tension. The 'coercive field'  $H_{sub} c/$  is also ignored as the model is intended to apply to situations in which the applied field greatly exceeds the coercive field. By expressing the equations of motion in reduced units, it has been possible to condense all constant  $H_{sub} A/$  growth sequences onto a single sequence and similarly all constant  $\phi$  dot sequences onto another. When expressed in compatible units these two reduced sequences are found to be closely equivalent. This demonstrates that growth at any instant depends mainly on the value of a single growth parameter and is only very weakly influenced by the history of the growth. The changing shape of the domain wall during the motion has been represented to high accuracy by the use of up to 92 symmetric pairs of wall segments. At fast flux-reversal rates per domain  $\phi$  dot, the field required to drive the expansion is shown to be proportional to  $\phi$  dot/sup 0.616/ and to the domain cross-sectional area to the power -0.191. 19 Refs.  
Primary Keywords: Domain Expansion; Constant Drive Field; Constant Flux-reversal Rate; Eddy-current Magnetic Fields; Ferromagnetic Alloy Tape Cores  
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10018  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
FORMATIVE TIME LAGS IN THE ELECTRICAL BREAKDOWN OF GASES  
J. Dutton, S.C. Haydon and F. Llaulllyn Jones  
University College of Swansea, Singleton Park, Swansea, Wales  
British Journal Of Applied Physics, Vol. 4, pp 170-175 (06/1953).  
The time rate of growth of ionization currents in a gas in a uniform electric field greater than that corresponding to the static sparking potential is investigated theoretically. This theoretical analysis is then applied to the breakdown of a gas at high values of the parameter  $\phi$  dot. It is shown that the same primary and secondary ionization processes which lead to a growth of pre-breakdown currents in agreement with experiment, and to the calculation of static sparking potentials in agreement with those measured, also lead to a rapid decrease of the formative time lag with increasing overvoltage. The introduction of some other quite different process to account for the short formative time lag is unnecessary. The present theoretical investigation, together with previous experimental and theoretical studies, therefore, lay the basis of a comprehensive view of the electrical breakdown of gases covering a wide range of parameters. Curves showing the dependence of the formative time lag on overvoltage, calculated by means of the above analysis, are given; these curves may be used to elucidate the various secondary ionization processes operative in the breakdown mechanism. 25 Refs.  
Primary Keywords: Ionization Current Growth; Uniform Electric Field; Static Sparking Potential; Formative Time Lag Decrease  
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10019  
(ENERGY STORAGE, CAPACITIVE)  
(Capacitors)  
FRINGING FIELDS IN A PARALLEL-PLATE CAPACITOR  
A. Maini and M. Gruen  
University of Washington, Seattle, WA  
American Journal Of Physics, Vol. 45, No. 9, pp 877-879 (09/1977).  
The fringing fields in capacitors are studied both experimentally and theoretically to determine a correction to the basic capacitance formula for a circular, parallel-plate capacitor. Plate separation is varied to allow comparison at several values of capacitance. A constant offset in capacitance is also found but is believed to be due to stray capacitance in the apparatus. 2 Refs.  
Primary Keywords: Capacitor Fringing Field; Idealized Model Corrections; Circular Parallel-plate Capacitor  
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10028  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
PLASMA PROPERTIES OF A METAL VACUUM ARC. I  
V.M. Luney, V.D. Oscherenko and M. Khoshikh  
Physicstechnical Institute, Academy of Sciences of the Ukrainian SSR, Kharkov, USSR  
Soviet Physics-Technical Physics, Vol. 22, No. 7, pp 855-861 (07/1977).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 47, 1486-1490 (July 1977)  
Certain characteristics of the plasma of a metal (Mo) vacuum arc are measured. The measurements are carried out with single and double electrostatic probes and a multigrad analyzer. The plasma density, the spatial distribution of the plasma density, the electron and ion temperatures, etc., are determined. The fluxes of ions and neutrals are estimated. It is found that a metal vacuum arc generates plasma streams with a directed ion energy of 20-30 eV. The plasma density is  $1E9 - 1E11$  cu.cm., and the electron temperature is approximately 3 eV. 9 Refs.  
Primary Keywords: Metal Vacuum Arc; Plasma Properties; Electrostatic Probes; Multigrad Analyzer;  $1E9 - 1E11$  per cu.cm. Plasma Density; 3 eV Electron Temperature; Spatial Distribution; Molybdenum Electrodes  
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10029  
(POWER CONDITIONING)  
(Pulse Transformers, Materials)  
POTENTIAL OF AMORPHOUS ALLOYS FOR APPLICATION IN MAGNETIC DEVICES  
F. E. Luborsky, J. J. Becker, P. G. Frischmann and L. A. Johnson  
General Electric Co., Schenectady, NY 12301  
Journal Of Applied Physics, Vol. 49, No. 3, pp 1769-1774 (03/1978).  
Amorphous alloys have potential applications in all types of magnetic devices. In both the electronic and power areas of application for electronic devices, the properties are comparable to those of commercial alloys and the materials offer potentially much lower cost. In power applications such as transformers, losses are far lower than in materials used at present. This results in a potential favorable trade-off between first cost and a substantial energy savings throughout the life of the device. Although power applications have not been emphasized up to now, they appear to hold great promise, especially as wider amorphous tapes become available. 39 Refs.  
Primary Keywords: Amorphous Alloys; Magnetic Devices; Market Structure; Fabricability; Annealing; Cost  
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10030  
(BREAKDOWN STUDIES)  
(Explosion, Foils)  
PULSED LASER STEPCHOGRAPHY OF MINIATURE EXPLODING FOILS  
D. L. Patisley  
Mingento Research Corp., Menasha, WI 54952  
SPIE, Vol. 97, pp 184-188 (02/1976).  
The results of a photographic study of exploding foils are presented. A pulsed ruby laser is used to illuminate the foil to freeze the explosion and to allow filtering of the plasma radiation. The image is recorded on a stereocamera. The analysis of the photographs is described, and a short discussion of results is presented. 4 Refs.  
Primary Keywords: Miniature Exploding Foils; Pulsed-Laser Stereochography; Optically Intense Plasmas; Framing Camera; Stereo Imaging  
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10031  
(ELECTROMAGNETIC COMPATIBILITY)  
(Grounding And Shielding)  
REDUCING ELECTRICAL INTERFERENCE  
E. S. Ida  
DuPont Co., Wilmington, DE 19888  
Control Engineering, Vol. 9, No. 2, pp 107-111 (02/1962).  
Grounding and shielding of remote sensors is the subject of this paper. Several definitions are presented and corrective measures for several grounding and shielding problems are considered. The author stresses that each problem is unique and should be considered so. 0 Refs.  
Primary Keywords: Electrical Interference; Cleaner Control Signals; Shielding; Ground Loops; Electrostatic Induction; Balanced Line  
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10035  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Specifications)  
SPECIFYING POWER CONDITIONING EQUIPMENT  
R. L. Anderson  
Maxwell Labs Inc., San Diego, CA 92123  
Electro-Optical Systems Design, pp 10-15 (03/1975).  
This paper should be very helpful to those who must specify a power conditioning system, whether it is to be constructed in-house or contracted. The process of specifying a system is considered in several steps with important points considered at each step. Some points of prime concern when specifying a system to a contractor are also discussed. 0 Refs.  
Primary Keywords: Power Conditioning System Specifications; Specification Determination  
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10036  
(ENERGY STORAGE, CAPACITIVE)  
(Capacitors)  
THE BEHAVIOR OF POLYESTER FILM ENERGY STORAGE CAPACITORS  
B. R. Hayworth  
Maxwell Labs Inc., San Diego, CA 92123  
IEEE Transactions On Electrical Insulation, Vol. EI-3, No. 2, pp 47-49 (05/1968).  
An experimental study of the electrical properties of energy storage capacitors utilizing Mylar polyester films has shown how the weight and volume of such capacitors could be reduced while improving reliability and energy density. Test data relate the lifetime of a capacitor to its operating voltage, discharge frequency, and temperature. The effect on life of percent current reversal and dielectric film thickness is also demonstrated. The results should enable capacitor designers to tailor products to specific applications, thereby achieving optimum performance. 0 Refs.  
Primary Keywords: Energy Storage Capacitors; Mylar Polyester Films; Percentage Current Reversal; Dielectric Film Thickness; Energy Density  
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10037  
(BREAKDOWN STUDIES; INSULATION, VACUUM)  
(Vacuum, Electrical)  
THE INSULATION OF HIGH VOLTAGES IN VACUUM  
J. G. Trump and R. J. Van De Graaff  
Massachusetts Institute of Technology, Cambridge, MA  
Journal Of Applied Physics, Vol. 18, No. 3, pp 327-332 (03/1947).  
Breakdown studies have been made between electrodes in high vacuum at constant voltages from 50 to 700 kV. These further demonstrate the inadequacy of the field emission theory to account generally for high voltage breakdown in vacuum. Experiments are described which investigate some of the "total voltage" breakdown mechanisms, including positive ion emission by electron impact, electron emission by positive ion impact and by photons. In the DC case these processes contribute to a steady interchange of charged particles between cathode and anode which increases with voltage until breakdown ensues. At higher breakdown voltages the cathode gradient has diminished far below the value for field emission. Measurements of electron emission by electrons with energies up to 300 kV for tungsten, steel, aluminum, and graphite are reported. The possibilities of predicting and of improving the insulation strength of electrode gaps in high vacuum by the study of the coefficients of the electrode materials are discussed. 13 Refs.  
Primary Keywords: Vacuum Insulation; 50 To 700 kV Constant Voltages; High Voltage Breakdown; Insulating Strengths; Electrode Materials; Field Emission  
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10039  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
TIME LAGS AND THE BREAKDOWN AND CORONA CHARACTERISTICS IN SULPHUR HEXAFLUORIDE  
E. Kuffel and R. D. Reduan  
University of Manchester, Manchester, UK  
Proceedings Of The IEE, Vol. 113, No. 11, pp 1663-1672 (11/1966).  
Uniform field breakdown of SF<sub>6</sub> at 60 Hz with variation of several gap parameters is the subject of this paper. DC voltages are utilized with superimposed square pulse voltages to overvolt gap and SF<sub>6</sub> 60 Hz gaps. Breakdown delay is measured as a function of gap spacing, pressure, irradiation, and breakdown history. SF<sub>6</sub> at 60 Hz is found to exhibit large scatter for low overvoltage. 20 Refs.  
Primary Keywords: Sulphur Hexafluoride Breakdown; Variable Gas Pressure; Electrode Conditioning; Time Lag; Breakdown Characteristics; Corona Current  
COPYRIGHT: 1966 IEE

10040  
(POWER TRANSMISSION)  
(Transmission Lines)  
USE OF RADIAL TRANSMISSION LINES IN PULSED ACCELERATORS  
V. I. Kazachov and I. V. Kozhukhov  
Soviet Physics-Technical Physics, Vol. 21, No. 7, pp 841-844 (07/1976).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 46, 1477-1483 (July 1976).  
Radial transmission lines with various electrode shapes are studied. An electrode configuration with a double-radial line can produce a voltage pulse in which the flat top drops by less than 10%. A multiple-gap pulsed accelerator can be constructed with double radial transmission lines of this kind. 8 Refs.  
Primary Keywords: Radial Transmission Lines; Various Electrode Shapes; Multigap Pulsed Accelerator; Radial Transmission Lines; Optimum Voltage Pulse; Transfer Characteristics  
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10041  
(BREAKDOWN STUDIES)  
(Explosion, Foils)  
VISIBLE AND NEAR-UV EMISSION IN THE ELECTRICAL EXPLOSION OF A THIN METAL FOIL  
V. I. Baikov, V. V. Blagoveshchenskiy, B. G. Komkov and Yu. T. Mazurenko  
Soviet Physics-Technical Physics, Vol. 20, No. 5, pp 708-719 (05/1975).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 45, 1128-1132 (May 1975).  
In a study of the electrical and optical characteristics of the electrical explosion of a thin aluminum foil in air it has been found that the light pulses obtained at energy inputs of up to 20 kJ/sq. cm. of foil have a brightness temperature of up to 35,000 Deg.K., a length of 4-6 microseconds, and a short rise time. It is found that approximately 35% of the electrical energy is converted into radiation. 10 Refs.  
Primary Keywords: Exploding Foil; Visible And Near-UV Emission; 35,000 Deg.K. Brightness Temperature; 4-6 Microsecond Light Pulse Length; 35% Electrical Energy Conversion Rate; Radiation Characteristics; High-Current Pulsed Discharge  
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10043  
(BREAKDOWN STUDIES)  
(Explosion, Wires)  
KERR-CELL STUDIES OF EXPLODING WIRES IN VACUUM  
S. Nyberg, S. K. Handel and B. Stenarhag  
Institute Of Physics, University Of Uppsala, Uppsala, Sweden  
Journal Of The Society Of Motion Picture Television Engineers, Vol. 82, No. 3, pp 187 (03/1973).  
The authors compare the optical emission of tungsten, molybdenum, and nickel wires using a single-frame Kerr-cell camera. Tungsten and molybdenum wires are chosen specifically for their high melting points while nickel is used for comparison. A model is presented. The explosion is found not to be dependent on radial electric field. 4 Refs.  
Primary Keywords: Exploding Wires; Kerr-cell Camera Shutter; Tungsten Wire; Molybdenum Wire; Nickel Wire; Radial E-Field Independence  
COPYRIGHT: 1973 THE SOCIETY OF MOTION PICTURE TELEVISION ENGINEERS

10048  
(PULSE GENERATORS)  
(Systems)  
NANOSECOND CURRENT PULSE GENERATOR FOR SUPPLYING SEMICONDUCTOR LASERS  
B. M. Kovelchuk  
Tomsk Polytechnic Institute, Tomsk, USSR  
Instruments And Experimental Techniques, No. 4, pp 884-887 (08/1968).  
Trans. From: Pribury i Tekhnika Eksperimenta 4, 116-119 (July-August 1968).  
A generator of nanosecond current pulses for powering semiconductor lasers is described. Current pulses with an amplitude to 1 kA and edge of 0.5 nsec at a repetition frequency of up to 1E4 Hz are obtained.  
Primary Keywords: Pulse Generators; Semiconductor Lasers; 1 kA Amplitude; 0.4 nsec Pulse Edge; 1E4 Repetition Frequency; 10-30 nsec Duration; 200 W Total Required Power; Rep-rated  
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10049  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Gas, Radiation; Gas Gaps, Optical)  
VOLT-AMPERE CHARACTERISTIC AND TRANSITION CURRENT OF A GAS GAP WHEN ACTED UPON BY PULSED IONIZING RADIATION  
V. A. Argubov, V. V. Zakharov, G. F. Toliev and E. V. Chikhunov  
Moscow, USSR  
Journal Of Applied Mechanics And Technical Physics, Vol. 18, No. 2, pp 154-156 (04/1977).  
Trans. From: Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki 2, 14-18 (March-April 1977).  
The problem of the reduction of the breakdown voltage of a gas gap when it is acted upon by a high-power ionizing pulse is considered. The prebreakdown transition currents are calculated for argon and air in the case of a wide gap (the distance between the electrodes d-1 cm). The problem of the form of the volt-ampere characteristic in the high-current range (the "glow" discharge model) was not considered. The purpose of the present paper is to calculate the volt-ampere characteristics of a narrow gas gap (d=2E-2 cm) in both the high- and low-current regions (the range of currents limited by space charge). 4 Refs.  
Primary Keywords: Gas Breakdown; Ionizing Radiation; Radiation Effect On Breakdown; Theory; Voltage Calculation; Current Calculation  
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10050

(BREAKDOWN STUDIES)  
(Vacuum, Electrical)

## BREAKDOWN OF VACUUM SPARK GAPS

R.C. Mason

Westinghouse Electric Corp., Pittsburgh PA  
Physical Review, Vol. 52, No. 2, pp 126-127 (07/1937).

Experiments with vacuum spark gaps show that the critical cathode field required for breakdown is reduced by considerable thermionic emission from the cathode. It is concluded that positive ion emission from the anode under electron bombardment, which apparently enters at higher voltages, is not a factor up to 50 kV. 7 Refs.

Primary Keywords: Vacuum Breakdown; Critical Cathode Field; Thermionic Emission; Anode Ion Emission; Gas Evolution; Metal Vaporization

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10055

(BREAKDOWN STUDIES: BREAKDOWN STUDIES)

(Vacuum, Electrical; Electrical)

## ELECTRODE PROTRUSIONS PRODUCED BY ELECTRON BEAM BOMBARDMENT AND THEIR ROLE IN VACUUM BREAKDOWN

A. Martland (1) and R. MacIver (2)

(1) International Research and Development Co Ltd, Newcastle-upon-Tyne, UK

(2) C.A. Parsons &amp; Co Ltd, Newcastle-upon-Tyne, UK

Brit J Appl Phys, Vol. 16, pp 1591-1592 (10/1965).

It was found that bombardment of copper samples by an electron beam in a vacuum chamber produced the formation of minute metallic protrusions on the copper surface. The possible bearing of such a process on the mechanism of electrical breakdown in high vacuum is considered. 9 Refs.

Primary Keywords: Vacuum Breakdown; Copper Electrodes; E-beam Bombardment; Microprotrusion Generation

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10073

(BREAKDOWN STUDIES)

(Vacuum, Electrical)

## VACUUM SPARK EROSION AT CATHODIC INCLUSIONS

J.T. Maskrey

Atomic Energy Research Establishment, Harwell, Berkshire, UK

British Journal Of Applied Physics, Vol. 16, pp 1583-1584 (10/1965)

Erosion found at inclusion sites in copper and stainless-steel cathodes after vacuum breakdown suggests that the vacuum arc initiation process may be closely related to that in unipolar arcs, where similar cathode damage occurs. 10 Refs.

Primary Keywords: Vacuum Breakdown; Electrode Erosion; Erosion Site Determination; Cathode Inclusions; Copper Cathodes; Stainless Steel Cathode

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10074

(PARTICLE BEAMS, ELECTRON)

(Generation)

## EXPLOSIVE EMISSION ELECTRONS FROM METALLIC NEEDLES

G.A. Masvets and D.I. Proskurnikov

Institute Of Atmospheric Physics, Academy of Sciences of the USSR, Moscow, USSR

JETP Letters, Vol. 13, No. 1, pp 4-6 (01/1971).

Trans. From ZhETF Pis'ma V Redaktsiyu 13, 7-10 (January 1971). Metallic needles are widely used as sources of electron current pulses of 1E3-1E5 A. It is customarily assumed that the emission of the electrons from the needles at such currents is due entirely to field emission. Our investigations have shown that the appearance of large electron currents is preceded by an electric explosion of the tip of the needle and the formation of a plasma as a result of resistive heating by the field emission current. 5 Refs.

Primary Keywords: Explosive Emission Electrons; Metallic Needles; 1E3-1E5 A Electron Current Pulses; Plasma Formation; Cathode Filaments; 10-500 kV Voltage Amplitude

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10106

(BREAKDOWN STUDIES)

(Vacuum, Electrical)

## THE RELATION BETWEEN ELECTRIC FIELD EMISSION AND CONTACT ELECTROMOTIVE FORCE FOR LIQUID MERCURY

D.H. Moore

University of Virginia, VA

Physical Review, Vol. 50, No. 4, pp 344-347 (08/1936).

The relation between contact EMF and the impulsive potential necessary to initiate a vacuum spark has been studied for a liquid mercury cathode. The magnitude and time of application of the impulsive potential were determined by a cathode-ray oscillograph so that possible distortion of the mercury surface produced by the electric field could be evaluated. For impure mercury no definite relation could be found. However, for carefully distilled mercury the relation between the work function and breakdown field was in qualitative but not in quantitative agreement with theory. 11 Refs.

Primary Keywords: Vacuum Breakdown; Mercury Cathode; Surface Distortion; Breakdown Voltage; Impulse Voltage; Field Emission

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10107

(BREAKDOWN STUDIES)

(Vacuum, Electrical)

## THE RELATION BETWEEN THE ELECTRIC FIELD EMISSION AND THE WORK FUNCTION OF LIQUID MERCURY

L.R. Quarles

University of Virginia, VA

Physical Review, Vol. 48, No. 3, pp 250-264 (08/1935).

The variation in the field necessary to initiate a vacuum discharge between a mercury cathode and a platinum anode and the accompanying variation in the work function of the cathode have been measured. The work function variations were obtained from measurements of the contact potential between the mercury and a platinum filament. The fields were applied by an impulse circuit to the time constant of the voltage was being very short in order to prevent distortion of the mercury. The final results show a variation of the field with work function which, while in the same direction, is more pronounced than that forecast by the Fowler-Nordheim theory. For a change of work function of one volt, the field required to initiate the discharge varied from 1.4 kV/cm to 5.5 kV/cm. 4 Refs.

Primary Keywords: Vacuum Breakdown; Mercury Cathode; Platinum Anode; Field Emission; Cathode Work Function

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10112

(REVIEWS AND CONFERENCES, BREAKDOWN STUDIES)

(Conferences; Exploding Wires)

## EXPLODING WIRES: VOLUME III

W.G. Chace (Ed.) (1) and H.K. Moore (Ed.) (2)

(1) AFCEC, Bedford, MA 01730

(2) Lowell Technological Institute Research Foundation, Lowell, MA

Publishing: Plenum Press, New York (01/1964).

Exploding Wires, Volume 3, contains the proceedings of the Third Conference on the Exploding Wire Phenomenon as its predecessors contained the proceedings of the earlier conferences. There are papers on theory, on shock waves, and on apparatus and instrumentation, recording the advances in the state of the art in each of these fields. A group of three papers on exploding bridge wires dominates the section on uses, but there is also a paper on chemical synthesis by E.M.'s. Exploding foils' entry into the R&D stage is described in a paper on a pulsed satellite accelerator. 196 Refs.

Primary Keywords: Exploding Wires; Theory; Shock Wave; Instrumentation; Bridge Wire; Opening Switch

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10119

(DIAGNOSTICS AND INSTRUMENTATION)

(Review)

## METHODS OF MEASURING VARYING AND PULSED MAGNETIC FIELDS (REVIEW)

N.S. Bobrov

Institute Of Nuclear Physics, Academy of Sciences of the USSR,

Moscow, USSR

Instruments And Experimental Techniques, No. 4, pp 963-972 (08/1970).

Trans. From Priroda 1, Tekhnika Eksperimenta 4, 7-16 (July-August 1970)

Methods of measuring varying and pulsed magnetic fields are reviewed systematically. Particular attention is given to methods of measuring fields up to non-relativistic 1E6 Oe. Six methods are considered: inductive methods; the ferroprobe method; methods using the Hall, Faraday, and Zeeman effects; and the magneto-resistive method. 40 Refs.

Primary Keywords: Magnetic Field Measurements; Pulsed Field; Comparison Of Several Methods; Ferroprobe; Hall Effect; Faraday Effect; Zeeman Effect; Magneto-resistive Method

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10123

(BREAKDOWN STUDIES)

(Solid, Electrical)

## ARC-INTERUPTION AND GAS-EVOLUTION CHARACTERISTICS OF COMMON POLYMERIC MATERIALS

P.F. Mettner

McGraw-Hill Co., Franklinville, NJ

IEEE Transactions On Power Apparatus And Systems, Vol. PAS-101, No. 6,

pp 1689-1696 (06/1982).

An extensive study was undertaken to determine the arc-interruption and gas-evolution characteristics of a number of common polymeric materials. The materials were evaluated to determine their potential use in electrical apparatus. The test results show the composition and distribution of arc-quenching gases produced during interruptions and the importance of volume cooling with gas on energy dissipation. A scheme is proposed for the arc-induced decomposition of a polymer and the predominant chemical reactions that account for the formation of the gas species observed is theoretically discussed. 6 Refs.

Primary Keywords: Polymeric Material; Breakdown; Evolved Gas Composition; Theory

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10124

(BREAKDOWN STUDIES)

(Gas, Electrical)

## A 7.2 kV - 63 kA ADVANCED PUFFER GAS CIRCUIT BREAKER

Y. Nagai, Y. Murai, A. Ohno and T. Tsutsumi

Mitsubishi Electric Corp., Amagasaki, Japan

IEEE Transactions On Power Apparatus And Systems, Vol. PAS-101, No. 6,

pp 1696-1702 (06/1982).

The characteristics of a puffer type SF<sub>6</sub> gas circuit breakers were discussed based on the thermodynamic simulation of arc quenching mechanism including the pressure generation by the arc plasma. The results of the simulation revealed that the puffer breaker with high interrupting capacity can be designed with much less cylinder volume and much less driving power compared with the breaker designed by the conventional way of increasing the mechanical strength of the cylinder in interrupting capacity. A compact puffer breaker with the interrupting capacity of 53 kA at 7.2 kV was developed based on the simulation. 2 Refs.

Primary Keywords: SF<sub>6</sub> Breakdown; Gas Recovery; Numerical Simulation; Geometry Considerations; Puffer Circuit Breaker

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10125

(BREAKDOWN STUDIES)

(Gas, Electrical)

## EXPERIMENTAL AND THEORETICAL STUDY OF A DC ARC IN A CONSTANT DIAMETER NOZZLE FLOW

H.T. Nagamatsu

General Electric Co., Schenectady, NY 12301

IEEE Transactions On Power Apparatus And Systems, Vol. PAS-101, No. 6,

pp 1518-1527 (06/1982).

The cold air flow field for a 1.27 cm constant diameter nozzle was determined for subsonic and transonic flow velocities. In addition, DC arc voltage, current and diameter measurements were made for an arc gap of 5.52 cm and a current of approximately 100A. Arc voltage increased rapidly as the flow velocity increased from zero to sonic velocity. Using a channel flow model with constant arc temperature and a flow energy integral for the convective cooling, analytical expressions were derived for the arc radius, electric field strength, arc voltage, resistance, and power as functions of the cold flow properties: current, and axial distance. Calculated arc voltages, resistances, and powers compare favorably with measured values. 24 Refs.

Primary Keywords: DC Arc; Flowing Gas; Subsonic Flow; Transonic Flow; Current Measurements; Voltage Measurements; Arc Diameter; Theory; Experiment

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10126  
(BREAKDOWN STUDIES)  
(Gas, Recovery)  
FACTORS INFLUENCING THE INTERRUPTING ABILITY OF SF<sub>6</sub>/SUB 6/ PUFFER  
BREAKER AND DEVELOPMENT OF 300KV-50KA ONE-BREAK CIRCUIT BREAKER  
S. Yanabu, M. Mizoguchi, A. Kobayashi, Y. Ozaki and Y. Murakami  
Toshiba Corp. Kawasaki, Japan  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-101, No. 6,  
pp 1511-1518 (06/1982).  
The factors to be considered at the design stage of the extinction  
chamber of a SF<sub>6</sub>/sub 6/ puffer gas circuit breaker (GCB) have been  
examined numerically and analytically. It has been shown that an  
extinction chamber which satisfies both Short Line Fault (SLF) and  
Breaker Terminal Fault (BTF) conditions simultaneously is not  
economical and a capacitor parallel to it should be used. On the  
basis of the above analysis, a 300KV-50KA one-break chamber has been  
developed successfully. 16 Refs.  
Primary Keywords: SF<sub>6</sub>/sub 6/ Breakdown; Gap Recovery; Puffer Circuit  
Breaker; Performance Test; Theory; Experiment  
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10127  
(INSULATION, MATERIAL)  
(Solid)  
PHYSICAL MODEL OF ELECTRIC AGING AND BREAKDOWN OF EXTRUDED POLYMERIC  
INSULATED POWER CABLES  
C. Bahder (1), T. Garrity (2), M. Soshinski (1), R. Eaton (2) and C  
Katz (1)  
(1) Cable Technology Labs, Inc., New Brunswick, NJ  
(2) U.S. Dept. Of Energy, Washington, DC  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-101, No. 6,  
pp 1379-1390 (06/1982).  
This paper postulates a physical model of electric aging and  
breakdown of polymeric insulated high voltage cables and  
substantiates this model with results of tests. In accordance with  
the model, scission of molecular chains and formation of craters at  
discharging voids are responsible for the electric aging and voltage  
breakdown of polymeric insulation. A method for the rapid  
determination of threshold voltage by means of voltage breakdown  
tests has been developed. These tests indicate that at voltage above  
the threshold voltage the breakdown voltage decreases with an  
increase of time of voltage application. At voltages below the  
threshold voltage electric breakdown is not expected. 33 Refs.  
Primary Keywords: Polymeric Insulation; Insulation Aging; Insulation  
Breakdown; Voltage Threshold Voltage  
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10128  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
RANDOM PREBREAKDOWN DISCHARGES IN SF<sub>6</sub>/SUB 6/ - A POSSIBLE DIAGNOSTIC  
CRITERION FOR PARTICLE-CONTAMINATED COMPRESSED GAS APPARATUS  
M. Anis (1), M.M.A. Saleem (2) and K.D. Srivastava (1)  
(1) University of Waterloo, Waterloo, Ontario, Canada  
(2) Ain Shams University, Egypt  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-101, No. 6,  
pp 1588-1595 (06/1982).  
The corona pulse voltage in SF<sub>6</sub>/sub 6/ gaps, under impulse  
voltages, is random in value; its randomness is related to the  
electrode geometry and is influenced by the gas pressure and the rate  
of rise of the applied voltage. An analytical model is presented  
whereby the relationships among these quantities are derived. The  
model predicts for a given electrode geometry at a certain gas  
pressure the distribution of the corona onset voltage. The results of  
testing rod-plane SF<sub>6</sub>/sub 6/ gaps under switching impulses are  
presented to verify the applicability of the analytical model. By  
establishing an electrostatic equivalence between rod-plane gaps and  
conducting particles in GIS, the above analysis could be extended to  
the latter problem. The possibility of using the present results and  
analysis to devise a diagnostic test procedure for  
particle-contaminated GIS is discussed. 9 Refs.  
Primary Keywords: SF<sub>6</sub>/sub 6/ Corona Pulse; Impulse Voltage; Electrode  
Geometry; Modeling; Onset Voltage Prediction;  
Nonuniform-field Gap  
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10129  
(POWER CONDITIONING)  
(Pulse Transformers)  
SOME TRANSMISSION LINE DEVICES FOR USE WITH MILLIMICROSECOND PULSES  
J.A.D. Lewis  
Radar Research Establishment  
Electronic Engineering, Vol. 27, No. 33, pp 447-453 (10/1955).  
Coaxial cables are very useful for implementing pulse transformers  
and phase inverters. This paper presents a brief theoretical  
background and design guides for such phase inverters and  
stacked-line pulse transformers. 8 Refs.  
Primary Keywords: Phase Inverter; Impedance Transformer; Nanosecond  
Pulses; Value Meter Isolating Transformer; Coaxial  
Cable  
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10130  
(SWITCHES, CLOSING; SWITCHES, CLOSING)  
(Thyristors, LASS)  
THYRISTOR DEVICES FOR ELECTRIC POWER SYSTEMS  
V.A.K. Temple  
General Electric Co., Schenectady, NY 12301  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-101, No. 7,  
pp 2276-2291 (07/1982).  
Thyristors of higher voltage and current ratings containing new  
gate and soft protection features are being developed at General  
Electric with EPRI (Electric Power Research Institute) support. Some  
of the more important of these are described in this paper. Devices  
include light triggered thyristors (LTT) at 6 and 8 kV  
level, and asymmetric light triggered thyristors (ALTT) with 50%  
higher surge capability and 50% faster turn-off times than a regular  
thyristor. New features include light-aided turn-off which protects  
thyristors from destructive failure during turn-off and voltage  
break-off (VBO) protection, which prevents destructive avalanche  
current turn-on. Brief descriptions of recent devices and status  
reports of our various EPRI supported programs are given. 8 Refs.  
Primary Keywords: Thyristor Switch; Light Triggered; High-voltage; Built  
In Voltage Breakdown Protection; Asymmetric thyristor  
 thyristor  
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10144  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
ON THE CATHODE OF AN ARC DRAWN IN VACUUM  
R. Tzberg  
Westinghouse Electric Corp., Pittsburgh PA  
Physical Review, Vol. 35, No. 9, pp 1280-1289 (05/1930).  
It has been found that the cathode is the only electrode which  
contributes vapor for the maintenance of an electric arc under very  
low gas pressure. The velocity of this vapor was determined by two  
methods. Method 1 consisted of measuring the force of reaction of the  
vapor on the cathode and the rate of vaporization of the cathode  
material. Method 2 consisted of determining the force exerted by the  
vapor on a vane suspended in front of the cathode spot and the rate  
of vapor condensation on the vane. Both these methods gave a vapor  
velocity of the order of 16x10<sup>6</sup> cm/sec. A temperature of around  
500,000 Deg K results when this value for the cathode vapor velocity  
is substituted for c in the equation 1/2 mc/sup 2/ = 3/2 KT. 10 Refs.  
Primary Keywords: Vacuum Breakdown; Cathode Effects; Cathode Vapor;  
Vapor Velocity; Temperature Calculation  
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10145  
VACUUM VOLTAGE BREAKDOWN AS A THERMAL INSTABILITY OF THE EMITTING  
CATHODE  
Breakdown by thermal instability of a field emitter is analyzed  
taking into account the temperature dependence of field emission and  
resistivity. Beyond a certain temperature the emission increases  
until the necessary field drops. It is shown that for a whisker-like  
emitter this instability occurs when the emitting tip is only several  
hundred degrees centigrade hotter than the bulk of the cathode.

10165  
(BREAKDOWN STUDIES)  
(Electrolytes, Electrical)  
PREBREAKDOWN PHENOMENA IN AQUEOUS ELECTROLYTES IN ULTRA-HIGH ELECTRIC  
FIELDS  
A.A. Vorobyev, V.V. Ryumov, O.V. Galkin, O.P. Semkina and V.Ya. Ushakov  
Applied Electrical Phenomena, No. 3, pp 28-32 (06/1971).  
Trans. From: Elektronnyye Obrebotke Materialov 3, (1971)  
Prebreakdown currents at high fields are studied in aqueous  
electrolytes. Several electrolytes with low voltage resistivities on  
the order of 100 ohm-cm are subjected to rectangular pulses with  
fields of 1E5-1E6 V/cm and pulse rise times <10 ns. Prebreakdown  
currents are measured as a function of field intensity and duration.  
The formation of a gas film near the electrodes is presented as a  
possible mechanism for current saturation. 10 Refs.  
Primary Keywords: Aqueous Electrolytes; 1E5-1E6 V/cm Electric Pulse  
Fields; Pre-breakdown Currents; Voltage Duration;  
Electric Field Intensity; Near-electrode Gas Film  
Formation  
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10168  
(BREAKDOWN STUDIES)  
(Surface Flashover)  
DEVELOPMENT OF SURFACE DISCHARGE ALONG A DIELECTRIC WITH LARGE  
DIELECTRIC CONSTANT IN GAS IN THE NANOSECOND RANGE  
B.M. Kavaliukhuk, V.V. Aramov, G.A. Mesyts and Ye.Ya. Yurik  
Academy of Sciences of the USSR, Tomsk, USSR  
Journal of Applied Mechanics And Technical Physics, Vol. 14, No. 1, pp  
39-44 (01/1973).  
Trans. From: Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki 1,  
42-55 (January 1973).  
The discharge from a metallic edge along the surface of a  
dielectric with dielectric constant of the order of 100 or larger is  
investigated. The dependences of the rate of expansion of the  
discharge, the time lag, and the volt-ampere characteristics are  
obtained for exposure times of the order of 1E-5 sec for plates made  
of barium titanate, titanium dioxide, and steatite ceramic with  
thickness of the order of 1 mm or less at voltages up to 1.5 kV of  
different polarity. The average rate of expansion of the figure of  
luminosity after a time of <3 nsec is equal to 1E6 cm/sec in order  
of magnitude. It is shown that from a negative point that discharge  
is initiated by the self-electron emission current, while from a  
positive point it is initiated by the self-ionization current. The  
oscillations are given for a computer utilizing surface  
discharge from a large number of points. 7 Refs.  
Primary Keywords: Surface Discharge Development; Large Dielectric  
Constant; Discharge Expansion Rate; Volt-ampere  
Characteristics; Self-electron Emission Current;  
Self-ionization Current  
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10171  
(PARTICLE BEAMS, ELECTRON; INSULATION, MAGNETIC)  
(Vacuum, Electrical)  
EXPERIMENTAL STUDY OF A MAGNETICALLY INSULATED DIODE FOR PULSE LENGTHS  
1E-5-5E-5 SEC  
I.M. Pustov, V.A. Burtsev, M.A. Vasilovskii and V.I. Engel'ko  
Soviet Physics-Technical Physics, Vol. 25, No. 5, pp 570-577 (05/1980).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 50, 944-956 (May 1980).  
Results of an experimental study of a magnetically insulated  
high-current diode are presented. It is demonstrated that the length  
of an electron current pulse in such a diode can be limited by  
breakdown along the surface of the accelerator chamber, caused by  
electrons escaping to the surface of the tube. Magnetic insulation of  
the accelerator has made it possible to achieve pulse lengths >1E-5s  
at voltages >400 kV across the tube with electron beam currents of  
4 kA. The study includes the dependence of the diode  
characteristics on the strength and the distribution of the magnetic  
field in the accelerating gap. The feasibility of using  
multiple-point large-surface-area cathodes to form cylinder electron  
beams is demonstrated. 9 Refs.  
Primary Keywords: Magnetically Insulated High-current Diode; >1E-5s  
Electron Current Pulse Lengths; <400 kV Voltages;  
3-4 kA Electron Beam Currents; Cylindrical Electron  
Beams; Multiple-point Large-surface-area Cathodes;  
Electron Beams  
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10174  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Vacuum; Electrical; Vacuum Gaps; Electrical)  
FORMATION OF NEW EMISSION CENTERS ON THE CATHODE IN THE PROCESS OF SWITCHING ELECTRICAL CURRENT IN A VACUUM. III. THE EFFECT OF A TRANSVERSE MAGNETIC FIELD  
D.I. Proskurovskii and V.F. Puchkarev  
Academy of Sciences of the USSR, Tomsk, USSR  
Soviet Physics-Technical Physics, Vol. 25, No. 10, pp 1235-1239 (10/1983)  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 50, 2120-2126 (October 1980)  
The formation of emission centers (EC) on the cathode when electrical current is switched in a transverse magnetic field is studied. It is shown that new EC arise in the direction of the plasma drift and they move with a velocity approximately 3E6 cm/s. The mechanism for their origin is discussed. A qualitative model is proposed for explaining EC, associated with anomalous motion of the cathode spot of the vacuum arc. 18 Refs.  
Primary Keywords: Vacuum Breakdown; Emission Center Formation; Transverse Magnetic Field; Plasma Drift; Cathode Spot Motion; Closing Switch  
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10175  
(BREAKDOWN STUDIES; INSULATION, MATERIAL)  
(Surface Flashover; Solid)  
MICRODISCHARGES ON THE SURFACE OF A DIELECTRIC IN A VACUUM  
E.M. Abdullin and S.P. Bugayev  
Institute of Atmospheric Optics, Academy of Sciences of the USSR, Moscow, USSR  
Soviet Physics Journal, Vol. 18, No. 2, pp 260-262 (02/1975)  
Trans. From: Izvestiya Vysshikh Uchebnykh Zavedenii, Fizika 18, 132-134 (February 1975)  
It has been previously shown that for a slow rise in the voltage on a dielectric located in a vacuum, a predischarge current is observed. This current has two components. One of them changes slowly in time, and its amplitude does not exceed 1E-11 to 1E-7 A, while the other consists of brief current surges of amplitude up to 1E-3 A. The experiments conducted previously indicate the important role of the constant component of the predischarge current in preparing the flashover process. Meanwhile, the reasons for the appearance of and the role of the microdischarges (self-extinguishing current surges which do not lead to breakdown) remain unclear. 7 Refs.  
Primary Keywords: Microdischarges; Predischarge Current; Dielectric Constant; Microscopic Spikes; Surface Dielectric Strength Increase  
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10177  
(REVIEWS AND CONFERENCES; BREAKDOWN STUDIES)  
(Conferences; Exploding Wires)  
EXPLODING WIRES: VOLUME IV  
M.G. Chace (Ed.) (1) and H.K. Moore (Ed.) (2)  
(1) AFRL, Bedford, MA 01730  
(2) Lowell Technological Institute Research Foundation, Lowell, MA  
Publisher: Plenum Press, New York (01/1968)  
This book is the record of the Conference on Exploding Wire Phenomena held October, 1967 in Boston, MA. As in previous cases, this volume contains papers on the relation of shock waves and exploding wires; or uses, particularly as exploding bridge wires; on chemical reactions induced by wire explosions; and on the general theory of the wire explosion itself. In addition, several new areas are covered. There are two papers on the resistivity-density relation in wire explosions. There are papers on the use of lasers and also on the use of x-rays for the study of exploding wires. Spectroscopy as applied to wire explosions is discussed in four papers. 286 Refs.  
Primary Keywords: Exploding Wire; Vaporization Wave; Comparison to Spark Discharge; Optical Output; Magnetic Field; Standing Wave; Diagnostics  
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10178  
(ELECTROMAGNETIC FIELD GENERATION; REVIEWS AND CONFERENCES)  
(Magnetics; Reviews)  
PULSED HIGH MAGNETIC FIELDS  
H. Kneepfel  
Lab Gas Ionizzati, Euratom-CEN, Frascati, Italy  
Publisher: North-Holland Publishing Co.-Amsterdam (01/1970)  
This book considers all aspects of magnetic field generation. The author proceeds from a short discourse on electromagnetic field theory to a thorough presentation on practical magnetic field generation. Field generation using capacitor banks, inductive stores, and flux compression are all discussed in detail. Aspects such as conductor deformation and vaporization are considered. A section on magnetic field and current measurement is included. 405 Refs.  
Primary Keywords: Magnetic Field Generation; Field Theory; Capacitor Bank; Inductive Store; Flux Compression; Field Effects; Conductor Deformation; Magnetic Pressure; Field Diagnostics  
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10179  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
THE "TEREK-2" HIGH-CURRENT PULSED ELECTRON ACCELERATOR  
Yu.F. Bondar, B.M. Kovalchuk, A.M. Rybalov and P.S. Strelov  
Academy of Sciences of the USSR, Tomsk, USSR  
Instruments And Experimental Techniques, Vol. 17, No. 1, pp 17-19 (02/1974)  
Trans. From: Priroda i Tekhnika Eksperimenta 1, 25-27 (January-February 1974)  
A pulsed electron accelerator having a current-pulse amplitude of up to 10 kA and a pulse length of 30 nsec is described. The energy of the electrons in the beam is controlled smoothly from 200 to 550 keV. The structural peculiarities of the accelerator allow injection of a beam into a quasi-stationary magnetic field without introducing substantial distortions into the field. 7 Refs.  
Primary Keywords: 10 kA Current-pulse Amplitude; 30 nsec Pulse Length; 200-550 keV Beam Energy; High-current Pulsed Electron Accelerator; Pulse Autotransformer; Double Shaping Line  
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10180  
(BREAKDOWN STUDIES; INSULATION, MATERIAL)  
(Surface Flashover; Solid)  
BEHAVIOR OF COMPOSITE INSULATION UNDER THE ACTION OF SUPERFICIAL ARCS. APPLICATION TO LINE INSULATORS  
B. Al. C. Muraux and A.M. Rahal  
Toulouse Univ. (France), Lab. de Genie Electrique  
Final Report, No. PUBL-378, 21p (12/1978)  
Availability: N80-17375/0  
NTIS  
Laboratory measurements were made in order to define the flashover mechanism observed on high voltage line insulators. Surface discharge propagation is considered to be due to the build-up of pollutants on the insulator surface. The laboratory apparatus, consisting of an open channel filled with an electrolyte, is described. This device represents a linear model of the electric equation under study. Variables are arc length, extent of polluted surface, and type as well as resistance of the electrolyte. Results determine experimentally the lowest voltage at which an arc sufficient to short-circuit the electrolyte develops. Some possible applications of this data to the improvement of insulators are then discussed.  
Primary Keywords: Flashover; Insulators; Power Lines; Surface Stability; Electric Arcs; Electrical Insulation; Electrolytes; Electrostatic Charge; High Voltages; Impurities  
Secondary Keywords: IN FRENCH; NTISMAAE; NTISNFV

10181  
(ELECTROMAGNETIC LAUNCHERS)  
(Exploding Wires)  
ELECTRIC GUN A VERSATILE TOOL FOR HIGH-PRESSURE SHOCKWAVE RESEARCH  
M.H. Chai (1), G. Dittbanner (2), W.W. Mofen (2), C.A. Monadel (2), D.J. Steinberg (2), J.R. Stroud (2), R.C. Weingart (2) and R.S. Lee (2)  
(1) Lawrence Livermore Lab, Livermore, CA 94550  
(2) Kansas State University, Manhattan, KS 66502  
The Review of Scientific Instruments, Vol. 51, No. 12, pp 1676-1681 (12/1980)  
We have developed a versatile tool for generating planar shock waves. This system, which we call the electric gun, is capable of projecting thin flyer plates with velocities in the range 1-20 km/s. It is presently being used in high-explosive-initiation experiments and is being developed for equation-of-state measurements in the 1-5 TPa range. We describe the electric gun facilities that are operational at Lawrence Livermore laboratory and discuss applications of electric gun technology to problems of interest to shock-wave researchers. 13 Refs.  
Primary Keywords: Dielectric Pallet Launchers; Exploding Wire; Shock Wave; 20 km/sec Velocity; Plastic/metal Laminate  
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10182  
(BREAKDOWN STUDIES)  
(Electrodes)  
ELECTRODE MATERIAL RELEASE DURING HIGH VOLTAGE BREAKDOWN (FINAL REPORT)  
G.W. Lebeck, T.B.I. McCall and R.T. Schneider  
University of Florida, Gainesville, FL  
No. NASA-TN-107880, 118p (01/1969)  
Availability: N70-17442  
NTIS  
Primary Keywords: Electrical Faults; Electrodes; Electron Emission; Electric Fields; Electric Potential; Electron Beams; Plasmas (physics); Vacuum Tubes

10183  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Data Transmission)  
HIGH VOLTAGE INSTRUMENT CABLES FOR 650 DEG.C IN-VESSEL BREEDER REACTOR SERVICE  
C.P. Cannon  
Hanford Engineering Development Lab., Richland, WA.; Department of Energy  
No. CONF-791037-5, 16p (07/1979)  
Availability: NED1-54-18375  
NTIS  
Two insulated in-core instrument cables have been developed for use in the Fast Flux Test facility (FFTF) and breeder reactor in-vessel environments. Prototype cables have been successfully fabricated and tested. Voltage Breakdown Pulse Noise (BPN) thresholds in excess of 300 Vdc and cable resistivities in excess of 10 exp 8 ohm-cm were achieved at temperatures to 650 exp 1 C. Factors most resistant to strongly affect breakdown phenomena and insulation resistance in bulk cable were insulation and backfill gas purity (especially as affected by fabrication processing), compaction density, and high temperature annealing. Substitution of copper electrical conductors did not adversely affect cable performance if fabrication parameters were appropriately adjusted. Preliminary gamma irradiation tests on bulk MgO cable indicate that the gamma flux decreases insulation resistance by an order of magnitude to 5 x 10 exp 9 ohm-cm at 450 exp 0 C. (ERA citation 05:008478)  
Primary Keywords: Electric Cables; Ftf Reactor; Lmf Type Reactors; Breakdown; Electrical Insulation; Magnesium Oxides; Performance; Reactor Instrumentation  
Secondary Keywords: ERDA/217510, ERDA/220600; NTISDE  
Distribution Restriction: Microfilm copies only.

10184  
(PULSE GENERATORS; SWITCHES, CLOSING)  
(Pulse Forming Lines; Gas Gaps; Electrical)  
HIGH VOLTAGE NANSECOND PULSE GENERATOR  
C. Zavelle  
Cornell Univ., Ithaca, NY 14853  
Interim technical report, no. 5, 1 May-31 Oct 79 (07/1980)  
Availability: AD-A087 291/1  
NTIS  
A parallel Blumlein circuit, combined with a spark gap switch, was designed for operation at 24 kV, 5,000 A peak. Tests were conducted with a single Blumlein with a 10 ohm load. Because of problems with breakdown in the triggered spark gap, a slightly larger spark gap was substituted. An acceptable pulse is delivered from the pulse forming network after adjustment of the inductive elements in the network. (Author)  
Primary Keywords: Pulse Generators; Test Lasers; Trigger Circuits; Spark Gaps; Electrical Networks; Electrical Loads; High Voltage; Pulse Rate; Transistors  
Secondary Keywords: Blumlein Circuits; Avalanche Transistors; NTISDD04; NTISDD0A

10185  
(BREAKDOWN STUDIES; INSULATION; MATERIAL)  
(Gas; Electrical; Dielectric)  
HIGH VOLTAGE RESEARCH (BREAKDOWN STRENGTHS OF GASEOUS AND LIQUID INSULATORS) AND ENVIRONMENTAL EFFECTS OF DIELECTRIC GASES. SEMIANNUAL REPORT, APRIL 1, 1979-SEPTEMBER 30, 1979  
L.G. Christophorou, D.R. James, R.Y. Pav, R.A. Mathis and I. Sauers  
Oak Ridge National Lab. Oak Ridge, TN 37830  
(01/1980)  
Availability: ORNL/TM-7173  
NTIS

A number of gas mixtures are suggested for industrial-scale testing. Electron attachment rates were measured and unfolded to give attachment cross section functions for CCl sub 3 F, CCl sub 2 F sub 2, and CClF sub 3 each in N sub 2, and for CCl sub 3 F in Ar. Electron attachment rates were measured also for n-C sub 6 F sub 14 in both Ar and N sub 2. The effects of molecular structure on energy, cross section, and lifetime of negative ion states of organic molecules were considered. A study was made of the potential role of electron detachment in breakdown. The role of dipolar scattering of electrons in inhibiting breakdown was investigated. The nature of synergisms among constituents of a gas dielectric mixture is discussed. Examples are cited from recent breakdown measurements. Breakdown measurements in plane-plane geometry were made for CF sub 4, 1,1,1-CH sub 3 CF sub 3, and CHF sub 3. Similar measurements were conducted with binary mixtures containing one of (i-C sub 4 sub 8, SF sub 6), and one of (CF sub 4, CH sub 2 F sub 2, 1,1,1-CH sub 3 CF sub 3, CH sub 2 F sub 2). Of special interest in these results were observed synergisms and the effect of dipole moment on the breakdown strengths. The initial fragmentation of 1,1,2-C sub 2 Cl sub 3 F sub 3 under electron impact was studied. Final decomposition products of sparked SF sub 6, 2-C sub 4 F sub 8 mixtures were identified and quantified. The breakdown products of SF sub 6 were studied. Impulse measurements

Primary Keywords: Chlorinated Aliphatic Hydrocarbons; Dielectric Materials; Fluorinated Aliphatic Hydrocarbons; Fluorinated Aromatic Hydrocarbons; Hexane; Sulfur Fluorides; Anions; Breakdown; Cross Sections; Electric Fields; Electron Attachment; Electron Detachment  
Secondary Keywords: ERDA/360603; ERDA/640304; Dielectric Breakdown; NTISDE

10186  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Systems)  
MEASUREMENT TECHNIQUES FOR HIGH POWER SEMICONDUCTOR MATERIALS AND DEVICES. ANNUAL REPORT, OCTOBER 1, 1977-SEPTEMBER 30, 1978  
National Bureau of Standards, Washington, DC National Engineering Lab.; Department of Energy  
No. NBSIR-79-1756, 144p (10/1979)  
Availability: DOE/RA-0041  
NTIS

Results of NBS research directed toward the development of measurement methods for semiconductor materials and devices which will lead to more effective use of high-power semiconductor devices in applications for energy generation, transmission, conversion, and conservation are reported. It responds to national needs arising from the rapidly increasing demands for electricity and the present crisis in meeting long-term energy demands. Emphasis is on the development of measurement methods for materials for thyristors and rectifier diodes. Application of this measurement technology will, for example, enable industry to make devices with higher individual power-handling capabilities, thus permitting very large reductions in the cost of power-handling equipment and fostering the development of direct current (dc) transmission lines to reduce energy waste and required rights-of-way. The major tasks under this project are to evaluate the use of thermally stimulated current and capacitance measurements and other deep level measurement techniques as a means for characterizing lifetime-controlling or leakage source defects in power grade silicon material and devices and to develop procedures to enable spreading resistance measurements of thyristor starting material and layer profiles to be made on a reliable basis. (ERA citation 05-006059)  
Primary Keywords: Semiconductor Devices; Semiconductor Materials; Measuring Methods; Operations; Performance Testing; Research Programs

Secondary Keywords: ERDA/420800; NTISDE

10188  
(ENERGY STORAGE; MECHANICAL; ENERGY STORAGE; INDUCTIVE; SWITCHES; OPENING; SWITCHES; OPENING)  
(Rotating Machines; Inductors; Mechanical; Explosive Fuses)  
DESCRIPTION OF THE ENERGY SOURCE PROJECT DELIVERING 1 MEGAJOULE IN 1 MICROSECOND  
F. Demidau and C. Rioux  
Paris University, Orsay, France  
No. LF-3, 17p (04/1972)  
Availability: NTIS-17454/1  
NTIS

The project for a high energy source delivering one MJ in one microsecond using a unipolar autoexcited ironless rotating generator is presented. Three subsystems are detailed: (1) the primary source mentioned above, delivering one MJ in 0.1 second with one MA current coupled to a magnetic storage coil; (2) a primary transfer coil with high efficiency (transfer time 100 microsecond and associated switching gear); and (3) a secondary transfer coil to reach one microsecond. Circuit breakers required for the various connections are detailed with regard to mechanical devices and exploding wire techniques. Mutually coupled inductances used for high efficiency transfer are described and the sequence of switch operations detailed.

Primary Keywords: Circuit Breakers; Electric Energy Storage; Electrical Engineering; Electromechanical Devices; Impulse Generators; Electric Fuses; Electric Power Transmission; Electrical Insulation; Energy Conversion Efficiency; Inductance  
Secondary Keywords: NASA

10189  
(ENERGY STORAGE; MECHANICAL; SWITCHES; OPENING)  
(Rotating Machines; Mechanical)  
FUSION R/D ON ADVANCED FUELS, HOMOPOLAR GENERATORS, CIRCUIT BREAKERS AND TOKAMAK DIAGNOSTICS  
W.E. Drummond  
University of Texas at Austin, Electric Power Research Inst., Palo Alto, Calif.  
Final rept. (09/1975)  
Availability: PB-248 322/05T  
NTIS

The general purpose of this program was two-fold: (1) To investigate theoretically the potential for the use of advanced fuel cycles and direct conversion in tokamak systems and the development of automated data acquisition systems for tokamaks, and (2) to explore both theoretically and experimentally the potential of homopolar generators and inductive energy storage devices as power supplies for future fusion experiments. The general outline of the program is discussed; a detailed description of the work done in each area is given; and a budget showing the actual expenditures incurred in the performance of the work is given.  
Primary Keywords: Nuclear Fusion; Nuclear Fuel Cycles; Circuit Breakers; Energy Storage; Numerical Analysis  
Secondary Keywords: Tokamaks; NTISEPR1

10190  
(PULSE GENERATORS)  
(Trigger)  
HIGH SPEED TRIGGER SYSTEM FOR TOTAL DEPOSITED ENERGY MEASUREMENT IN A LIQUID ARGON CALORIMETER  
J.E. Grund  
Stanford Research Institute, Menlo Park, CA 94025  
No. CONF-781033-28, 5p (10/1978)  
Availability: SLAC-PUB-2216  
NTIS

A system to produce trigger signals measuring the total energy deposited in the liquid argon/lead shower counters of the SPERK Mark II Detector at the Stanford Linear Accelerator Center is described. The trigger signals are developed by summing, filtering, and discriminating the signals from several thousand preamplifiers connected to the liquid argon detector strips. The system requirement of trigger information 430 ns after a particle has entered the shower counter led to a special filter design in which a leading edge sampling technique was utilized. A filtered signal representing the total deposited energy is measured by a fast level discriminator that is strobed in synchronism with the 4 x 4 x 4 beam crossings of the SPEAR storage ring. This sampling of the filtered waveform produces a digital output that is delivered to the trigger logic. (ERA citation 04-024387)  
Primary Keywords: Shower Counters; Trigger Circuits; Amplifiers; Argon; Design; Efficiency; Filters; Liquids; Logic Circuits; Preamplifiers; Signals; Stanford Linear Accelerator Center

Secondary Keywords: ERDA/440104; ERDA/430303; NTISDE

10191  
(BREAKDOWN STUDIES)  
(Electrodes)  
HIGH VOLTAGE BREAKDOWN INITIATED BY PARTICLE IMPACT  
J.F. Frilichtent, D.O. Hanson and J.C. Slattery  
Space Technology Labs Inc, Redondo Beach, CA  
No. NASA-CR-63185, 9p (04/1965)  
Availability: NTIS-25467  
NTIS

Primary Keywords: Electrode; Gap; Impact; Particle; Voltage Breakdown; Acceleration; Breakdown; Dependency; Experiment; Formation; Gas; High Voltage; Polarity; Steel; Stress; Voltage

10192  
(BREAKDOWN STUDIES; SWITCHES; CLOSING)  
(Vacuum; Electrical; Vacuum Gases; Solid)  
EMISSION CHARACTERISTICS OF AN EXPLOSIVE GALLIUM CATHODE  
G.M. Fursak and V.M. Zhukov  
A.A. Zhdanov Leningrad State University, Leningrad, USSR  
Soviet Physics-Technical Physics, Vol. 19, No. 6, pp 804-807 (12/1974).  
Trans. from: Zhurnal Tekhnicheskoi Fiziki 44, 1280-1286 (June 1974)  
The temporal characteristics and emission properties of the initial stages of vacuum breakdown are studied. An attempt is made to distinguish processes related to the parameters of the external circuit from those due directly to the emission properties of the cathode. The delay times and switching times are measured during the development of vacuum breakdown on the surfaces of liquid and solid gallium with a limited emitting surface and on extended electrodes. The explosive-emission current displays saturation due to the limited cathode emissivity. 10 Refs.  
Primary Keywords: Vacuum Breakdown; Explosive Cathode Emission; Temporal Resolution; Delay Measurement; Switching Time Measurement

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10193  
(BREAKDOWN STUDIES)  
(Electrodes)  
HIGH-VOLTAGE CHARACTERISTICS OF A LARGE-GAP COAXIAL-CYLINDER ELECTRODE  
K.F. Koral  
Lewis Research Center, Cleveland, OH  
No. NASA-TN-D-3949, 24p (05/1967)  
Availability: N67-24617  
NTIS

The splicing and termination of underground electrical distribution cable requires that the integrity of cable conductor and insulation be maintained throughout its length. A large number of commercial cable splice and termination kits are available which are claimed to fulfill these requirements. The Civil Engineering Laboratory (CEL) was requested to investigate the suitability of these kits for use at Naval shore facilities. Of special interest were the slip-on cable splice and cable termination for solid dielectric insulated cable. These slip-on devices proved to be the easiest and fastest to install with good reproducibility, and the electrical characteristics were as good as, or better than, the other types of cable splice and cable termination kits tested. (Author)  
Primary Keywords: Concentric Cylinder; Electrode; Performance Characteristics; Conditioning; Current; Electrogenesis; High Voltage; Insulation; Leakage; Micropulsation; Rate; Solid; Vacuum

10194  
(INSULATION, MATERIAL)  
(Solid)  
DESTRUCTION OF POLYMER DIELECTRICS BY PARTIAL DISCHARGES  
M.A. Bagrov, M.A. Kurbanov and E.A. Garapashov  
Institute Of Physics, Academy of Sciences of the Azerbaizhan SSR,  
Soku, USSR  
Soviet Physics-Technical Physics, Vol. 20, No. 1, pp 55-57 (07/1975).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 45, 93-96 (January 1975)  
The influence of the energetic characteristics of individual  
microscopic discharges on the destruction (erosion) of polyethylene  
has been studied. The destruction of a polymer dielectric by partial  
discharges is shown to be due primarily to the energy which is  
transferred directly to the surface of the dielectric where it is in  
contact with the microscopic discharges. 5 Refs.  
Primary Keywords: Polyethylene Insulation; Partial Discharges;  
Insulation Destruction; Microscopic Discharge;  
Energy Release  
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10198  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
THERMAL ANODE INSTABILITY IN THE PREBREAKDOWN STAGE OF VACUUM BREAKDOWN  
V.A. Mavrovskii  
All-Union Institute, Moscow, USSR  
Soviet Physics-Technical Physics, Vol. 23, No. 11, pp 1317-1322  
(11/1978)  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 48, 2301-2308 (November 1978)  
Local anode heating by the prebreakdown field-emission current is  
studied. Evaporation of the anode and of adsorbed films on the anode  
is examined. In the prebreakdown stage of vacuum breakdown, the anode  
heating can become unstable even before an electron-ion avalanche  
appears in the vapor. This instability is due to the additional heat  
excitation at the anode which results from increased electron current  
associated with ionization of the vapor produced by the hot anode.  
28 Refs.  
Primary Keywords: Vacuum Breakdown; Prebreakdown Current; Anode  
Heating; Metal Vapor; Electron Avalanche; Ion  
Avalanche  
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10199  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES)  
(Vacuum, Electrical; Electrodes)  
MOTION OF THE CATHODE SPOT OF A VACUUM ARC IN AN INHOMOGENEOUS MAGNETIC  
FIELD  
I.I. Aksenov and A.A. Andreev  
Khar'kov Physicotechnical Institute, Academy of Sciences of the  
Ukrainian SSR, Khar'kov, USSR  
Soviet Technical Physics Letters, Vol. 3, No. 12, pp 525-526 (12/1977).  
Trans. From: Pis'ma Zhurnal Tekhnicheskoi Fiziki 3, 1272-1275  
(December 1977)  
6 Refs.  
Primary Keywords: Vacuum Arc; Cathode Spot; External Magnetic Field;  
Spot Motion; Retrograde Motion; Cold Cathode  
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10200  
(ELECTROMAGNETIC COMPATIBILITY)  
(Lightning)  
LIGHTNING EFFECTS RELATING TO AIRCRAFT: PART II. CHARACTERISTICS OF  
SIMULATED LIGHTNING FLASHES AND THEIR EFFECTS ON LIGHTNING ARRESTERS  
AND AVIONIC EQUIPMENT  
F.A. Fisher, B. Macchiarelli and D.L. Jones  
General Electric Co., Pittsfield, MA 01201  
Final rept. 15 Nov 69-15 Oct 71 No. SRD-72-054-2, 94p (01/1972).  
Availability: AD-900 249/25T  
NTIS  
Measurements were made of the degree to which a lightning arrester  
could limit the voltage on avionic equipment when an external  
lightning arrester was struck by a simulated lightning stroke. The  
tests show that breakdown is not an instantaneous affair, but rather  
takes many microseconds. Measurements taken near a point which is  
struck indicate that the air around any protrusions will be in a  
state of electrical breakdown whenever the electrical field strength  
at the aircraft surface approaches 100 kV/meter. Electrical  
discharges tend to limit the field strength to that value, thus  
defining the electrical environment to which the avionic equipment  
is subjected. Data is presented showing how the impedance effects the  
voltages impressed on avionic equipment before the spark gaps in the  
protecting lightning arrester break down. Measurements were made of  
the spectral density of radiation from long electrical arcs used to  
simulate lightning strokes to aircraft. The relative amplitude at  
different frequencies seems to agree with that observed from natural  
lightning, falling at a 1/f rate in the vicinity of 1 MHz. (Author-P1)  
Primary Keywords: Lightning Arresters; Aircraft; Airframes; Lightning;  
Simulation; Burning Rate; Airplane Panels; Sparks;  
Shock Waves; Composite Materials; Acoustic  
Impedance; Electromagnetic Shielding; Electric  
Fields; Electric Arcs; Voltage; Air; Electrodes;  
Damage  
Secondary Keywords: Avionics; F-106 Aircraft; F-4 Aircraft; NTISDDDDX  
Distribution Restriction: Distribution limitation now removed.

10201  
(ELECTROMAGNETIC COMPATIBILITY)  
(Lightning)  
LIGHTNING EFFECTS RELATING TO AIRCRAFT: PART III. MEASUREMENTS OF  
LIGHTNING-INDUCED VOLTAGES IN AN F4H-1  
J.A. Plumer  
General Electric Co., Pittsfield, MA 01201  
Final rept. Nov 71-Jan 73 No. SRD-72-054-3, 122p (03/1973).  
Availability: AD-910 158/55T  
NTIS  
Measurements of possible lightning-induced voltages on several  
electrical circuits within an F4H-1 aircraft are reported. The  
measurements were made using the transient analysis technique in  
which simulated lightning currents identical in waveshape but reduced  
in amplitude from that of natural lightning are passed through the  
aircraft. The resulting induced voltages are then scaled upward in  
direct proportion to natural lightning amplitude. When scaled to a  
scale lightning stroke of 200,000 amperes as described in  
MIL-B-50879, Para. 3.3.4.5, voltages induced in the measured circuits  
ranged between several millivolts and several thousand volts. Factors  
influencing the susceptibility of a particular circuit included:  
circuit routing, function, electrical return path and exposure to  
direct contact with lightning currents at extremities such as NAV  
lights and pitot heaters. The circuits receiving the highest induced  
voltages include those in which associated components have been  
damaged as reported in actual F-4 lightning stroke incident reports.  
The results indicate that a combination of voltage limiting spark gap  
devices and lower voltage surge suppressors may be effective in  
limiting many of these voltages to safe levels, but the maximum  
transient voltage withstand levels of connected avionic and power  
system equipment should be determined before maximum safe voltage  
limits can be established. The advent of solid state avionics and  
nonmetallic structural materials in future  
Primary Keywords: Lightning; Jet Fighters; Jet Fighters; Electrical  
Equipment; Transients; Damage Assessment; Voltage;  
Simulation; Electric Discharges; Electronic  
Equipment; Composite Materials; Circuits;  
Interference; Lightning Arresters; Electromagnetic  
Compatibility  
Secondary Keywords: Avionics; F-4 Aircraft; Lightning Strikes;  
Sidewinders; NTISDDDDX  
Distribution Restriction: Distribution limitation now removed.

10204  
(ELECTROMAGNETIC COMPATIBILITY)  
(Grounding And Shielding)  
R.F. SHIELDING PERFORMANCE OF REINFORCED METAL FILLED CONDUCTIVE  
PLASTIC FLAT GASKETS  
J.E. Ehrreich and M. Nimoy  
Chomerics, Inc., Plainville, MA  
IEEE Transactions On Electromagnetic Compatibility, Vol. 7, No. 1, pp  
50-54 (03/1965).  
A paper presented at the Fifth Annual Symposium introduced this  
group to the remarkable R.F. shielding potentials of the electrically  
conductive plastic materials based on the new types of spherical  
metal fillers. It was stated in this paper that the conductive  
plastics have volume resistivities as low as 1E-5 ohm centimeters  
and, when properly used in a flange, would give total attenuations in  
the range of 75 to 100 db over the frequency range of 50 kc to 10 Gc.  
Further testing during the past year has established that these are  
conservative figures. 1 Ref.  
Primary Keywords: Conductive Plastic; EMC Shielding; 100 db  
Attenuation; 75 kHz-10 GHz Bandwidth; Easily Machined  
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10206  
(ELECTROMAGNETIC COMPATIBILITY)  
(Grounding And Shielding)  
SHIELDING EFFICIENCY OF ELECTRICALLY CONDUCTIVE PROTECTIVE COATINGS FOR  
MAGNESIUM AND ALUMINUM SURFACES  
A.L. Albin  
Fairchild Space and Defense Systems, Syosset, NY  
IEEE Transactions On Electromagnetic Compatibility, Vol. EMC-6, No. 2,  
pp 31-35 (07/1964).  
Although several proprietary finishes have been available for  
aluminum and magnesium protection from corrosion, the electrical  
properties at radio frequencies have never been sufficiently defined.  
In order to evaluate the relative merits of such finishes for  
aluminum and magnesium, a test program was established. Fixtures were  
designed to measure bonding impedance from DC to RF, and to evaluate  
shielding efficiency and insertion loss from gaskets used in joint  
interfaces. Marked differences in performance were observed between  
the radio frequency shielding obtained at radio frequencies and the  
bonding impedance measurements, indicating that the commonly used  
interior of DC or RF bonding impedance is not sufficiently sensitive  
to provide good control of conductive coatings. Corrosion tests  
indicated several finishes would be acceptable from both the  
corrosion and electrical viewpoint. 0 Refs.  
Primary Keywords: EMI Shielding; Wavelength Measurement; Moving Parts;  
Corrosion Resistance; Metal Coatings; Life Test  
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10209  
(SWITCHES, OPENING)  
(Explosive Fuses)  
THE PERFORMANCE OF ELECTRICAL FUSES UNDER IMPULSIVE CONDITIONS I: DC  
SUPPLIES  
C.P. Wheeler  
Imperial College Of Science And Technology, London, UK  
Journal Of Physics D: Applied Physics, Vol. 5, No. 1, pp 133-140  
(01/1972)  
The action integral is used to evaluate the rupturing times and  
rupturing currents of fuse elements in inductive circuits. With a  
suitable choice of variables it is shown that all fuses and circuits  
can be represented by the one equation and there is excellent  
agreement with measurements made on copper fuses. Particular  
attention is given to the stored magnetic energy at the time of  
rupture, since this energy has to be dissipated in the ruptured fuse  
material. Again, with a suitable choice of variables, a general  
relation between current cut off ratio and pre-arcing energy is  
derived. The existence of a maximum in this relation has been known  
for many years but the treatment here puts the whole problem on a  
general quantitative basis. Impulsive performance is considered in  
conjunction with steady state performance in a quest for the best  
fuse element material. Silver appears to be the outstanding material,  
with the much-used copper some way down in the list of metals.  
Finally, the impulsive pressure produced in cartridge fuses is  
considered and good qualitative agreement with measurements obtained  
in the case of a treatment based on radiation pressure. 12 Refs.  
Primary Keywords: Explosive Fuse; Induct; Creepage Discharge; Tap  
Water; Dielectric Surface; Flange Length; Solid  
Permittivity; Field Configuration; Pulse Length  
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10210  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
THE ROLE OF POSITIVE IONS IN HIGH VOLTAGE BREAKDOWN IN VACUUM  
M.C.J.C.R.W. Bourne and J.G. Trump  
Massachusetts Institute of Technology, Cambridge, MA  
Availability: PB-168 912  
NTIS

Measurements were made of the electron emission from targets of aluminum, steel, magnesium, copper, gold, and lead when bombarded by ions from hydrogen, helium, nitrogen, xenon, and mercury. The ions, whose energy was varied over the range from 10 to 140 kilovolts, were produced by ionization of the residual gas in the anode electrode and emerged through a small opening into an essentially uniform accelerating field. An initial rapid rise in electron emission with ion energy was followed in all cases by a slow linear increase. The emission ratio varied from 2 to 20 and was maximum for nitrogen ions on steel. The dependence on extractive gradient at the bombarded metal surface was slight and no simple dependence on the nature of the ion or of the bombarded metal was observed. The significance of these measurements on the electron-ion interaction theory of high voltage breakdown in vacuum is discussed. (Author)

Primary Keywords: Ion Bombardment; Vacuum; Secondary Emission; Metals; Electrons; Ions; Voltage; Gas Ionization; Aluminum; Steel; Magnesium; Copper; Gold; Lead; Hydrogen; Helium; Nitrogen; Xenon; Mercury

10211  
(PULSE GENERATORS)  
(Capacitor Banks)  
CURRENT PULSE GENERATOR WITH AMPLITUDE OF 1,000,000 A AND STABILITY OF  $\pm 0.001$  AT A REPEATITION RATE OF TWO HZ  
R.F. Boyanov, N.V. Iliriyev, M. Pekin, A.P. Panov and G.I. Silvestrov  
P.D. Wagh-Patterson AFB, OH  
No. FTD-ID(RS)T-1291-77, 16p (08/1977)  
Trans. From: Trudy Vsesoyuznogo Soveshchaniya po Uskoritel'yam Zaryazhennykh Chastits, Vol. 1, pp 283-286 (1970) By C.S. Mack  
Availability: AD-A049 390/85T  
NTIS

It is often necessary to create powerful generators which operate on an inductive load in order to obtain strong magnetic fields, as well as to use pulsed systems in acceleration equipment. Furthermore, experimental conditions sometimes place limitations on the duration and form of the current pulse and the stability of current amplitude, and also require high operating reliability. This report examines a generator which provides a unipolar sinusoidal current pulse with a base length of 1.2 ms and an amplitude of 1,000,000 amperes. It is stable with precision of  $\pm 0.001$  at a repetition rate of several hertz for an inductive load of 0.1 microhenry.

Primary Keywords: Pulse Generators; Inductance; Acceleration; Magnetic Fields; Gates/Circuits; Reliability/Electrical; Thyristors; Pulse Transformers; Voltage Regulation; Capacitors; Transistors; USSR  
Secondary Keywords: NTISDDXA

10213  
(ENERGY STORAGE, MECHANICAL)  
(Rotating Machines)  
POSSIBILITY OF USING A HOMOPOLAR GENERATOR AS A PULSE GENERATOR  
A.K. Des Gupta  
Regional Engineering College, Rourkela, Orissa, India  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-87, No. 3, pp 650-655 (3/1968)  
A homopolar machine has been analyzed to ascertain whether it is possible to use it as a high-current, low-voltage pulse generator. A transient expression for the field flux has been deduced and the time constant determined. The effect of the eddy currents produced in the solid metal body of the machine has been included and an expression for the flux density due to eddy currents has been deduced, as well as an expression for the transient current in the magnetizing coil.  
7 Refs.

Primary Keywords: Homopolar Generator; Horizontal Design; Theory; Field Flux Expression; Eddy Currents; Transient Current Calculation  
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10214  
(ENERGY STORAGE, MECHANICAL)  
(Rotating Machines)  
PULSED HIGH-VOLTAGE AND HIGH-CURRENT OUTPUTS FROM HOMOPOLAR ENERGY STORAGE SYSTEM  
R.D. Ford, D. Jenkins, W.H. Lupton and J.M. Witkowski  
Naval Research Lab, Washington, DC 20335  
The Review Of Scientific Instruments, Vol. 52, No. 5, pp 694-697 (05/1981)

Pulsed energy source with a versatile output, using self-excited homopolar generator for the initial storage of energy, has been developed. Large energy storage of this inertial-inductive system provides an attractive option for satisfying pulse power requirements associated with such applications as plasma confinement and heating, electro-magnetic acceleration of projectiles, and with production of intense radiation. These applications require high rate of energy delivery to the load at specific current and voltage levels, have been obtained by incorporating unique current interrupting system. The overall pulsed efficiency, which depends sensitively on the load characteristics was measured over a range from 10% to more than 90% for different pulsed-load circuit arrangements. 10 Refs.

Primary Keywords: Self-excited Homopolar Generator; Inductive Store; Transfer Efficiency; Opening Switch; Load Considerations  
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10215  
(BREAKDOWN STUDIES)  
(Surface Flashover)  
TEMPERATURE DEPENDENCE OF SURFACE FLASHOVER VOLTAGE OF POLYETHYLENE IN VACUUM

Y. Ohki and K. Yahagi  
Waseda University, Tokyo, Japan  
Journal Of Applied Physics, Vol. 46, No. 8, pp 3695-3698 (08/1975)  
The surface flashover voltage over cylindrical spacers made of polyethylene in vacuum under impulse voltage application decreases monotonically with increasing temperature of the sample surface. This temperature dependence may be explained well by the mechanism that electrons injected from a cathode-insulator-vacuum junction bombard the sample surface to cause desorption of adsorbed gases and vaporization of sample material, thereby triggering surface flashover. 5 Refs.

Primary Keywords: Surface Flashover; Polyethylene; Vacuum; Impulse Voltage; Surface Preparation  
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10217  
(BREAKDOWN STUDIES)  
(Gas, Recovery)  
ELECTRON ATTACHMENT IN SULFUR HEXAFLUORIDE USING MONOENERGETIC ELECTRONS  
W.M. Hickam and R.E. Fox  
Westinghouse Research and Development Center, Pittsburgh PA  
The Journal Of Chemical Physics, Vol. 25, No. 6, pp 642-647 (06/1956)

Results are presented of an experiment to determine the attachment processes leading to formation of SF/sub 5/ and SF/sub 6/ ions. Monoenergetic electrons were used to determine the attachment cross section for several energies. The significance of the attachment cross section variation is discussed with respect to measuring electron energy distributions. 9 Refs.

Primary Keywords: SF/sub 6/ Attachment; SF/sub 5/ Attachment; Attachment Cross Section; Variation With Energy  
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10218  
(BREAKDOWN STUDIES)  
(Gas, Recovery)  
INVESTIGATIONS OF THE PROPERTIES OF SF/SUB 6/ AS AN ARC QUENCHING MEDIUM  
W. Hertz, H. Motschmann and H. Wittal  
Siemens AG Research Lab, Erlangen, FRG  
Proceedings Of The IEEE, Vol. 59, No. 4, pp 485-492 (04/1971)

The results of experiments on stationary and nonstationary arcs in SF/sub 6/ are summarized. High temperature gas properties, like the electrical and thermal conductivity as well as the theoretically predicted plasma damping effects, are determined by electrical and spectroscopic measurements. Investigations on interrupted DC arcs give insight into the energy transport mechanism of the arcs. The transient temperature behavior of gas blast interrupted arcs is measured. Finally, the application of the investigations to circuit breaker arcs is discussed. The following principal results have been found. From the time constant of blown N/sub 2/ arcs in comparison to SF/sub 6/ arcs above 10000 K it follows that the good quenching properties of SF/sub 6/ must be due to processes taking place below 10000 K. This agrees also with the time-constant measurements in the interrupted cascade arc: at lower temperature-below approximately 8000 K-the conduction decay in N/sub 2/ is very much slower than in SF/sub 6/. 13 Refs.

Primary Keywords: SF/sub 6/ Arc Quenching Properties; High-temperature Electrical Conductivity; Thermal Conductivity; Energy Transport; DC Arc Interruption; AC Arc Interruption; Gas Blast Circuit Breaker  
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10219  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
THE INFLUENCE OF GAS STREAMS AND MAGNETIC FIELDS ON ELECTRIC DISCHARGES: PART 3-ARCS AT PRESSURES UP TO 18 ATMOSPHERES IN ANNULAR GAPS  
V.W. Adams  
Aeronautical Research Council (Gt. Brit.)  
No. ARC-CP-968, 22p (01/1968)  
Availability: AD-13425  
NTIS

Primary Keywords: Angular Velocity; Arc Discharges; Gas Streams; Magnetic Annular Arc; Magnetic Fields; Carbon Arcs; Electric Arcs; Nitrogen; Pressure Effects; Propagation Velocity; Rotation; Spark Gaps

10220  
(PULSE GENERATORS)  
(Capacitor Banks)  
HIGH VOLTAGE, HIGH CURRENT, PULSED ENERGY SOURCE HAVING DI/DT'S OF 2E12 A/S  
L.C. Burkhardt, R.S. Dike, J.M. DiMarzio, R.A. Haerman and A.E. Schofield  
Los Alamos National Lab, Los Alamos, NM 87545  
No. CONF-751125-51, 4p (01/1975)  
Availability: LA-UR-75-2129  
NTIS

A hybrid transfer capacitor circuit, combining one back-biased and a forward-biased capacitor bank, plus a resistor for damping and isolation) and an inductive load has achieved inductive-storage, explosive fuse-like rates of rise, and peak amplitudes, of currents. Initial di/dt's of approximately 2E12 A/s are measured, with currents in the 200 kA range. The combination of explosive fuses and magnetic energy storage has been successfully used at Los Alamos Scientific Lab. for generating currents with risetimes of 2E12 A/s and of 200 kA magnitude, on both linear and toroidal Z pinches. Such a system must have the characteristic of initially high vector E fields during the formation of the pinch, but with low vector E fields along the plasma chamber's wall after the pinch has been formed. The voltage left on a simple capacitor system will cause secondary wall breakdown, which short-circuits the previously formed pinch. (Conceivably a crowbar of extremely low inductance could then remove the residual voltage; in practice, however, the attendant L/R decay time is too short for most pinch experiments.)

Primary Keywords: Power Supplies/Performance; Energy Storage/Performance; Toroidal Pinch Devices/Power Supplies; Linear Z Pinch Devices/Power Supplies; Capacitors; Switching Circuits  
Secondary Keywords: NTISERDA

10221  
(PULSE GENERATORS; PULSE GENERATORS)  
( Marx Systems)  
HIGH-VOLTAGE SYSTEM FOR THE RISK FACILITY: PART 1. BIPOLAR GENERATOR MODEL OF VOLTAGE PULSES WITH THE AMPLITUDE UP TO 200 KV  
L.S. Vertogradov, A.V. Zhelazkov and G.A. Shelkov  
Joint Inst. for Nuclear Research, Dubna (USSR)  
(01/1976)  
Availability: JINR-R-13-9740  
NTIS

A bipolar high-voltage pulse generator intended for supplying large streamer chambers is described. This new type of the generator may be regarded as two Arkadev-Marx generators assembled so that the first controlled discharger is common for both the generators. This ensures high synchronism of two output pulses as compared with a system consisting of two independent unipolar generators. Test results of a bipolar generator model are presented as histograms and dependences of principal characteristics upon external parameters. Based upon the results obtained the following conclusions have been drawn: output signal amplitudes hardly depend upon trigger amplitudes, optimum operating conditions of the generator with respect to pressure and supply voltage are close to the generator self-triggering region. All the parameters of the generator do not depend upon response frequency ranging from 2 to 6 cps. (Atomizdatykh 09 376682)

Primary Keywords: High-voltage Pulse Generators; Streamer Spark Chambers; Capacitors; Diagrams; Electrodes; Frequency Dependence; Performance Testing; Resistors; Spark Gaps  
Secondary Keywords: IN RUSSIAN; ERDA/440300; USSR; NTISINIS  
Distribution Restriction: U.S. SALES ONLY.

10222  
(INSULATION, MATERIAL)  
(Gas)

SULFUR HEXAFLUORIDE

J.T. Milek  
Hughes Aircraft Co. Culver City, CA 90230  
Data sheets No. ds-140, 2p (10/1964).  
Availability: AD-607 949

NTIS

A compilation of the electrical properties of sulfur hexafluoride, a dielectric gas, is presented. Electrical properties include corona, dielectric constant, dissipation factor and dielectric strength. The latter property data section is segregated into parameter effects as follows: pressure, gap distance, temperature, electrode configurations and gas mixtures. Each property is compiled over widest possible range of parameters obtained in a thorough search of the world's literature. (Author)

Primary Keywords: SULFUR COMPOUNDS FLUORIDES; FLUORIDES SULFUR COMPOUNDS; ELECTRICAL PROPERTIES; DIELECTRICS; DATA; GRAPHICS; DIELECTRIC PROPERTIES; ELECTRONICS

10223  
(DIAGNOSTICS AND INSTRUMENTATION; INSULATION, MAGNETIC)  
(Voltage)

MEASUREMENT OF MAGNETICALLY INSULATED LINE VOLTAGE USING A THOMSON PARABOLA CHARGED PARTICLE ANALYSER

T.D. Stanley and R.W. Stinnett  
Sandia Labs, Albuquerque, NM 87115  
No. CONF-810325-1, 2p (01/1981).  
Availability: SAND-80-2685C

The absence of direct measurements of magnetically insulated line voltage necessitated reliance on inferred voltages based on theoretical calculation and current measurements. This paper presents some of the first direct measurements of magnetically insulated transmission line peak voltages. These measurements were made on the Sandia National Laboratories HydrATE facility. The peak voltage is measured by observing the energy of negative ions produced at the line cathode and accelerated through the line voltage. The ion energy and the charge-to-mass ratio are measured using the Thomson Parabola mass spectrometry technique. This technique uses parallel E and B fields to deflect the ions. The deflected ions are detected using a microchannel plate coupled to a phosphor screen and photographic film. The Thomson Parabola results are compared to Faraday Cup measurements and to calculated voltages based on current measurements. In addition, the significance of observed positive ions is discussed. (ERA citation 06:017881)

Primary Keywords: Inertial Confinement; Beam Transport; Electric Potential; Ion Beams; Measuring Instruments; Photographic Films; Power Supplies; Thomson Scattering

Secondary Keywords: ERDA/700203; ERDA/700208; NTISDE

10224  
(REVIEWS AND CONFERENCES)  
(Reviews)

HIGH POWER ELECTRON AND ION BEAM CONFERENCE

J.A. Nation and R.H. Sudan  
Cornell University, Ithaca, NY 14850  
(01/1977).  
Availability: CONF-771035-P1

Separate abstracts were prepared for each of the 37 included papers. (ERA citation 06:037945)  
Primary Keywords: Electron Beams; Inertial Confinement; Ion Beams; Meetings; Leading Abstract  
Secondary Keywords: ERDA/700208; NTISDE

10225  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)

HIGH-VOLTAGE PULSE REFLECTION-TYPE ATTENUATORS WITH SUBNANOSECOND RESPONSE

R.J. Thomas  
Lawrence Livermore Lab, Livermore, CA 94550  
IEEE Transactions On Instrumentation And Measurement, Vol. IM-16, No. 2, pp 146-154 (06/1967).  
Significant advances have been achieved in high-voltage pulse attenuation and measurement fidelity by utilizing the principle of traveling-wave reflection at an abrupt impedance mismatch along a transmission line. Such 'reflection-type' attenuators allow practically distortionless attenuation of the signal, independent of voltage level. Their rise-time response and attenuation factor can be known very accurately because they are free from voltage and temperature effects making them especially suited as high-voltage pulse calibration standards. The rise-time response for such attenuators can readily attain 100 ps or less, a practical limit being about 33 ps. 14 Refs.

Primary Keywords: Voltage Attenuation; Transmission Line Impedance Mismatch; Reflected Wave; Transmitted Wave; Low Distortion; Fast Rise  
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10226  
(PARTICLE BEAMS, ELECTRON)  
(Generation)

INTENSE, MILLISECOND ELECTRON BEAMS

F.M. Cherbouner, J.P. Barbour, J.L. Dyke, W.P. Brewster and F.J. Grundhauser  
Field Emission Corp. McMinnville, OR 97128  
IEEE Transactions On Nuclear Science, Vol. NS-14, No. 3, pp 789-793 (04/1967).

Pulsed radiation sources of higher intensity and shorter duration are desired to broaden the scope of experimental studies of radiation-induced phenomena. For this purpose, a family of generators has been developed which can produce intense pulsed beams of electrons. The highly reproducible beam is extracted from the accelerating tube through a thin window and can be injected readily into other experimental apparatus. Available pulse durations range from 3 to 50 nanoseconds. The maximum electron energy can be adjusted continuously from 150 to 600 keV, or from 500 keV to 2 MeV, depending on the specific generator. Available peak beam currents range from 1,000 to 10,000 amperes, and the electron output can be varied from 1E13 to 2E15 electrons per pulse. When desired, the output beam can be concentrated magnetically to energy densities in excess of 100 cal/cm<sup>2</sup>, creating shock waves and permitting study of materials under intense transient stress. The basic design concepts, and diagnostic techniques developed or adopted for reliable measurement of the beam characteristics, will be discussed. 0 Refs.

Primary Keywords: E-beam Generation; Marx Generator; Field Emission Diode; Design Considerations  
Secondary Keywords: Bremsstrahlung Radiation  
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10227  
(BREAKDOWN STUDIES)  
(Gas, Optical)

INTERACTION OF LASER-INDUCED IONIZATION WITH ELECTRIC FIELDS

J.R. Greig (1), R. Pacheco (1), M. Raleigh (1), I.M. Vitkovitsky (1), R. Fernier (2) and J. Halle (2)  
(1) Naval Research Lab, Washington, DC 20375  
(2) JAYCOR Inc, Alexandria, VA 22304  
13th AIAA Fluid And Dynamics Conference, Snowmass, CO, Paper 8-1380, 6p (07/1980).

New results are discussed concerning the guiding of a discharge channel by laser beam. The authors utilize a Nd:glass laser to guide an electrical discharge over distances up to 2 m. Arcs breakdown by the laser supplies the guiding mechanism. A wide range of guiding distances and delays are studied. 21 Refs.

Primary Keywords: Laser Discharge Guiding; Nd-glass Laser; 2 m Guiding Distance; Variable Distance; Arcs Breakdown; Variable Delay

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10232  
(SWITCHES, CLOSING)  
(Vacuum Gaps, Electrical)

A TRIGGERED VACUUM SPARK-GAP SWITCH

L.M. Ornstein, C.A.J. Hugenholz and M.A. Van Der Laan  
FOM-Instituut voor Plasma-Fysica, Rijnhuizen, Jutphaas, The Netherlands  
Journal Of Scientific Instruments, Vol. 42, pp 659-661 (08/1965).

A vacuum spark-gap switch which is triggered by plasmas has been operated in a voltage range from 18 kV to below 50 V. Delays of 75-60 nsec and a jitter below 3 nsec have been found in the most suitable polarity. The self-induction of the switch is about 3.5 nH; the resistance is in the order of 1 million 11 Refs.

Primary Keywords: Vacuum Spark Gap; Trigatron Configuration; Delay Measurement; Jitter Measurement; Low Inductance; 1 Million Resistance; 50 V-18 kV Operating Range

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10233  
RESEARCH AND DEVELOPMENT ON DC CIRCUIT BREAKERS (FINAL REPORT)

G.A. Hofmann, G.L. Garber, W.E. Reed and I.A. Shilling  
Hughes Research Labs, Malibu, CA 90265  
(02/1977).

Availability: EPRI-EL-379

NTIS

The development of a laboratory prototype of an HVDC circuit breaker and testing of this prototype on the Pacific MW-SW DC Intertie is described. A new concept in breaker configuration was implemented and tested. The fundamental difference from previous concepts was the use of separate devices to perform the following breaker functions: carrying the continuous current; interrupting fault or load current; and absorbing energy. A unique electronic interrupter was developed which is capable of interrupting over a thousand amperes against one hundred kilovolts. An ultra-fast, in-line mechanical switch, capable of full opening (1 in.) in 1.6 milliseconds, was developed and tested on a power system. (ERA citation 02:034031)

Primary Keywords: Circuit Breakers; HVdc Systems; Design; Performance Testing; Research Programs

Secondary Keywords: ERDA/200302; NTISEFAP

10234  
A TECHNIQUE FOR MEASURING NON-SQUARE PULSED HIGH VOLTAGES TO  $\pm 0.25$  PERCENT ACCURACY

J.W. Holm-Hennedy and T.P.C. Ku  
University of California, Los Angeles, CA 90024  
Final rept. (02/1972).  
Availability: PB-266 686

NTIS

An accurate technique for measuring a wide range of pulsed voltages and currents of large magnitude (kilovolts and amps) and short duration at either low or high repetition rates is described. The technique is accurate for both square and nonsquare pulses. The technique is particularly useful for measuring the J-E characteristics (current density - electric field) of semiconductors at high electric fields. The unknown voltages are matched on a CRO to voltage-dividers; zero diode limited pulses which are accurately known. The sample circuit and reference pulse circuits are given. (Author)

Primary Keywords: Semiconductors; Electrical Measurement; Tests; Current Density; Electric Field; Electric Potential; Pulse Circuits

10235  
(BREAKDOWN STUDIES)  
(Gas, Products)

ARC STABILITY OF ELECTRONEGATIVE GASES

J.P. Menion, J.A. Philosophos and M.B. Robinson  
Allis-Chalmers, Milwaukee, WI

IEEE Transactions On Electrical Insulation, Vol. EI-2, No. 1, pp 1-10 (04/1967).

The decomposition of electronegative gases in electric discharges was studied to determine relative chemical stabilities and the effect of the discharge on dielectric strength. Rate of disappearance of the parent molecule and variation in dielectric strength with arcing time were determined. Good correlation was noted between atomic composition, molecular complexity and stability of the gases to discharge. In the fluorocarbon series the partial substitution of chlorine for fluorine or an increase in molecular complexity by the introduction of the carbon-carbon bond resulted in decreased discharge stability. The major gaseous product of all fluoro- and chlorofluoro-carbons studied was CF<sub>4</sub> which was itself almost unaffected by the discharge. A group of molecules of relatively simple structure was found to possess a unique degree of discharge stability. 10 Refs.

Primary Keywords: Gas Breakdown; Breakdown Products; Several Gases; Prebreakdown Stability vs Molecular Complexity; Fluorocarbon Gases; Simple Gases

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Pulse transformers are often employed in circuits which are used to trigger spark gaps. There are limitations in the use of this type of generator when a high degree of accuracy is desired. To operate large-area, high-power light sources with Kerr cell shutters for the photography of high-velocity particle impacts, synchronization of the light source with the shutter is accomplished with a jitter of no more than a few millimicroseconds. Pulse and trigger spark gap conditions for millimicrosecond triggering are defined. Several transformerless, trigger-pulse generators are described. One of these has been used to trigger 50-kilovolt spark gaps with jitter of less than 2 millimicroseconds. A number of techniques for synchronizing the firing of a gap with a pulse are used and some of these techniques are given. Several methods for pulsing Kerr cells using accurately triggered spark gaps are also described. (Author)

Primary Keywords: TRIGGER CIRCUITS; SYNCHRONIZING SWITCHES; SYNCHRONIZING SWITCHES; TRIGGER CIRCUITS; KERR CELLS; ELECTROMAGNETIC PULSES; TRIGGER PULSES; TRIGGER PULSES; PULSE GENERATORS; HIGH-SPEED PHOTOGRAPHY; SPARK

Secondary Keywords: SPARK GAP TRIGGER CIRCUITS

10238 COMBINATION OF PBFA I LINES IN A DISK FEED  
J.T. Crow and G.D. Peterson  
Sandia Labs, Albuquerque, NM 87115  
No. SAND-81-0778C, 6p (01/1981).  
Availability: DE81028213

10240  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Current)  
A METHOD FOR MEASURING VERY HIGH SPEED TRANSIENT CURRENTS  
A. M. Zarem and F. P. Marshall  
Naval Ordnance Division, Pasadena, CA  
The Review Of Scientific Instruments, Vol. 20, No. 2, pp 133-134  
(02/1949)

10241  
(POWER CONDITIONING)  
(Pulse Transformers)  
COMPACT TRANSFORMER BASED ON SECTIONS OF COAXIAL CABLE  
A.N. Meshkov and V.I. Shishko  
Instruments And Experimental Techniques, Vol. 19, No. 5, pp 1440-1442  
(10/1976).  
Trans. From: Priroda i Tekhnika Eksperimenta 5, 166-168  
(September-October 1976).

12043  
[PULSE GENERATORS; ELECTROMAGNETIC LAUNCHERS;  
(Flux Compression); Railguns]  
EXPLOSIVE FLUX COMPRESSION GENERATORS FOR RAIL GUN POWER SOURCES  
G.M. Fowler, D.R. Peterson, R.S. Caird, D.J. Erickson, B.L. Freeman and  
J.C. Kramers  
Los Alamos National Labs, Los Alamos, NM 87545  
IEEE Transactions On Magnetics, Vol. MAG-18, No. 1, pp 64-67 (01/1982).  
A class of explosive magnetic flux compression generators is  
described that has been used successfully to power rail guns. A  
program to increase generator current magnitudes and pulse lengths is  
outlined. The design elements and their advantages are discussed, and plans  
to control some of them are outlined. Included are various  
modifications of the conventional strip generators that are more  
resistant to undesirable expansion of generator components from  
magnetic forces. Finally, an integral rail gun is discussed that has  
coaxial geometry. Integral rail guns utilize the rails themselves as  
flux compression elements and under ideal conditions are  
theoretically capable of driving projectiles to arbitrarily high  
velocities. Integral coaxial rail guns should be superior in some  
respects to their square bore counterparts. 9 Refs.  
Primary Keywords: Rail Gun; Coaxial Geometry; Flux Compression  
Generator; Explosive Driver; Component Integration

10255  
(ELECTROMAGNETIC FIELD GENERATION)  
(Magnetic)  
SURFACE EFFECT IN STRONG MAGNETIC FIELDS. I

10253  
(BPEAKDOWN STUDIES)  
(Vacuum, Electrical)  
CRITERION FOR VACUUM SPARKING DESIGNED TO INCLUDE BOTH RF AND DC  
x-j.pattick, W.D.  
University of California, Berkeley CA  
The Review of Scientific Instruments. Vol. 28, No. 10, pp 824-826  
(12/1957).

11/19/57). The empirical relation is presented that describes a boundary between no vacuum sparking and possible vacuum sparking. Metal electrodes and RF or DC voltages are used. The criterion applies to a range of surface gradient, voltage, gap, and frequency that extends to the range of the present study. The surface field alone is considered necessary for sparking, but in addition energetic ions are required to initiate a cascade process that increases the emitted currents to the point of sparking.

Primary Keywords: Vacuum Breakdown; RF Breakdown; DC Breakdown; Variable Voltage; Variable Gap Spacing; Field Emission; Empirical Relation

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10259  
(BREAKDOWN STUDIES; PARTICLE BEAMS, ELECTRON)  
(Vacuum, Electrical; Generation)  
FIELDS CURRENTS FROM POINTS  
C.F. Eyring, S.S. Mackeown and R.A. Millikan  
California Institute of Technology, Pasadena, CA  
Physical Review, Vol. 31, No. 5, pp 900-909 (05/1928).  
The laws governing the extraction of electrons from metals in high vacuum by fields, first developed through experiments with crossed wires, then with fine wire cathodes discharging to cylindrical anodes, have been now found to hold throughout for field currents between points and planes. The theory needed for the quantitative determination of the potential gradients at points is here given, and critical gradients then determined experimentally. The generality of the linear relation between  $\log i$  and the reciprocal of field-strength is experimentally established. 11 Refs.  
Primary Keywords: Vacuum Breakdown; Field Emission; Potential Gradient; Crossed Wires; Wire-cylinder Configuration  
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10260  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
INVESTIGATION OF HIGH-VACUUM ELECTRICAL BREAKDOWN  
L.V. Terasova and V.G. Kalinin  
Soviet Physics-Technical Physics, Vol. 9, No. 4, pp 514-520 (10/1964).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 34, 666-675 (April 1964).  
Some features of high-vacuum electrical breakdown are investigated for different electrode shapes and materials in various vacuum chambers and in ultra-high vacuum in the voltage range 20-300 kV. The pulse coefficients for various pulse shapes and durations from 1E-7 to  $9 \times 1E-5$  sec do not exceed 1.7 as a rule and are independent of distance between electrodes. The delay in the electrical breakdown relative to the instant the voltage is applied may reach several microseconds, but in the majority of cases it is practically absent. 18 Refs.  
Primary Keywords: Vacuum Breakdown; Several Electrode Configurations; Several Electrode Materials; Delay Measurement; Voltage Measurement  
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10261  
(BREAKDOWN STUDIES; SWITCHES, CLOSING)  
(Vacuum, Electrical; Vacuum Gaps, Electrical)  
MINIMUM ENERGY FOR INITIATION OF ELECTRICAL BREAKDOWN IN VACUUM  
I.N. Slivkov  
Soviet Physics-Technical Physics, Vol. 11, No. 6, pp 795-797 (12/1966).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 36, 1084-1086 (June 1966).  
The initiation of vacuum breakdown between electrodes of different materials at voltages up to 120 kV by an auxiliary spark is investigated. The minimum energy required to create a pilot spark capable of initiating vacuum breakdown was measured. For an aluminum cathode the minimum energy is  $1E-6$  J. 1 Refs.  
Primary Keywords: Vacuum Breakdown; Different Electrode Materials; 120 kV Gap Voltage; Trigger Spark; Minimum Trigger Energy  
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10262  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
PHOTOGRAPHIC OBSERVATIONS OF A PREBREAKDOWN DISCHARGE TRANSITION BETWEEN METAL ELECTRODES IN VACUUM  
D.J. DeGester  
Argonne National Lab, Argonne, IL  
Journal Of Applied Physics, Vol. 34, No. 4 (Part 1), pp 919-920 (04/1963).  
Photomicrographs were made of the electrode gap between a spherical molybdenum anode and a like stainless steel cathode at voltages near the breakdown limit. At a discrete voltage for a particular gap, ionized patches of about 1.05 mm in diameter appeared on the anode surface. These ionized areas occurred in luminosity and number with voltage until one or more degenerated into a highly unstable incandescent spot undergoing severe localized heating. Both of these events lead to breakdown at these sites, providing evidence for a complex vacuum breakdown process related to the prebreakdown discharges observed. 7 Refs.  
Primary Keywords: Vacuum Breakdown; Prebreakdown Currents; Sphere-sphere Gap; Molybdenum Anode; Stainless Steel Cathode; Anode Spots  
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10264  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
PRE-BREAKDOWN CONDUCTION IN CONTINUOUSLY-PUMPED VACUUM SYSTEMS  
W.K. Mansfield  
Nuclear Engineering Lab, London, UK  
British Journal Of Applied Physics, Vol. 11, pp 454-461 (10/1960).  
Measurements have been made under impulse conditions of the coefficients  $A'$ , the number of  $H/sup 4/$  ions emitted per 250 keV  $H/sup 4/$  ion, and  $B'$ , the number of  $H/sup 4/$  ions emitted per 250 keV  $H/sup 4/$  ion, for metal surfaces covered with the contaminating layers likely to be formed in continuously-pumped high-voltage apparatus. The values obtained for  $A'$  were 1.0, 1.1 and 0.54, and for  $B'$  0.43, 0.24 and 0.4 for copper, aluminum and steel targets respectively. The product of these coefficients is such as to make very probable the hypothesis that pulse discharge conduction in these systems is due to the regenerative exchange of positive and negative ions of hydrogen. The transient nature of this form of conduction is thought to be due to the charging up of the insulating contaminant. 20 Refs.  
Primary Keywords: Vacuum Breakdown; Prebreakdown Current; Regenerative Ion Exchange; Insulator Charging  
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10265  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)  
PREBREAKDOWN CONDUCTION BETWEEN ELECTRODES IN ULTRA-HIGH AND HIGH VACUUM  
L.I. Pivovarov and V.I. Gordienko  
Soviet Physics-Technical Physics, Vol. 7, No. 10, pp 908-912 (04/1963).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 32, 1230-1236 (October 1962).  
The effect of the surface state of the electrodes on prebreakdown conduction was investigated. It was found that after high-temperature heating of the cathode a steady current appears at voltages much less than the microdischarge initiation voltage. The steady current is assumed to be caused by field emission occurring after the heating of the electrodes and after the action of microdischarges as a result of vacuum etching, which leads to the formation of micro-points on the surface of the electrodes. It was also found that after high-temperature heating of the anode the microdischarge initiation voltage is increased and there is a current due to thermionic emission in the electric field. Oxidation of the anode was found to restore the threshold microdischarge voltage. 10 Refs.  
Primary Keywords: Vacuum Breakdown; Prebreakdown Current; Electrode Surface Condition; Cathode Heating; Field Emission; Microprojection  
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10267  
(PARTICLE BEAMS, ION)  
(Generation)  
SMALL-APERTURE DIAPHRAGMS IN ION-ACCELERATOR TUBES  
L. Cranberg and J.B. Marshall  
Los Alamos National Labs, Los Alamos, NM 87545  
Journal Of Applied Physics, Vol. 30, No. 5, pp 708-710 (05/1959).  
An investigation has been made to determine the conditions under which the voltage sustained by a 2-ft length of ion accelerator tube may be made proportional to the length of the tube. It has been found that such linearity may be obtained if the tube is segmented at 4 1/2 in. intervals by diaphragms which are so arranged that no straight path is possible from one end of the tube to the other. No significant deterioration in performance of the tube was observed when axial holes were made in each diaphragm up to 3/4 in. in diameter. The voltage gradient realized on these tests was 60 kV/cm. 4 Refs.  
Primary Keywords: Ion Beam Generation; Voltage Linearity; Diaphragm Voltage Gradient; 60 KV/cm Voltage Gradient  
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10268  
(SWITCHES, OPENING)  
(Mechanical)  
THE BRIDGE STAGE OF ELECTRODE EROSION IN SWITCHING 1000-5000-A CURRENTS IN VACUUM  
V.S. Potokin, V.I. Rakhovskii and V.M. Tikhonov  
All-Union Institute, Moscow, USSR  
Soviet Physics-Technical Physics, Vol. 10, No. 10, pp 1424-1427 (04/1966).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 35, 1848-1852 (October 1965).  
When an electric current is switched off by separating electrodes the entire current passes through the point of last contact. The Joule heat evolved as a result melts the area of current concentration and as the electrodes are further separated this area is formed into a small molten-metal bridge. The study of the bridge stage is interesting, particularly when the contacts are separated in vacuum, because the resulting vapor cloud creates a medium in which a so-called vacuum arc is formed. None of the presently available publications on the bridge stage of erosion treat the behavior of the bridge at very high currents. For these reasons we have studied the bridge stage of erosion that arises when large currents are switched in vacuum. 6 Refs.  
Primary Keywords: Mechanical Opening Switch; Current Interruption; Molten Metal Bridge; Vacuum Arc; Electrode Erosion; Tungsten Electrodes  
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10270  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
THE ROLE OF INCLUSIONS AND SURFACE CONTAMINATION ARC INITIATION AT LOW PRESSURES  
J.T. Mearns and R.A. Dugdale  
Atomic Energy Research Establishment, Harwell, Berkshire, UK  
British Journal Of Applied Physics, Vol. 17, pp 1023-1034 (08/1966).  
This paper is concerned with the initiation mechanism of electric arcs in low-pressure gas discharge apparatus. It is demonstrated experimentally that arcs are initiated at the sites of inclusions in the surfaces of metal cathode probes exposed to a hydrogen plasma. The presence of relatively volatile extraneous contamination is also necessary, however, for arc initiation to occur under the present experimental conditions (hydrogen ion current density  $10 A/cm^2$ , cathode field  $1E5 V/cm$ ). A mechanism for arc initiation involving the production of bursts of cathodic vapour is postulated, in which an essential event is the dielectric breakdown of insulating inclusions. 22 Refs.  
Primary Keywords: Gas Breakdown; Low Gas Pressure; Cathode Inclusions; Stainless Steel Cathode; Arc Initiation  
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10271  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
THE SPECTRAL ENERGY DISTRIBUTION AND OPACITY OF WIRE EXPLOSION VAPORS  
J.A. Anderson  
Carnegie Mellon University, Pittsburgh PA 15213  
Proceedings Of The National Academy Of Sciences Of The U.S.A., Vol. 8, No. 7, pp 231-232 (07/1922).  
This paper presents results of a study of the spectra of exploding wires. It is found that a wire exploded between two planes emits a continuous spectrum and the absorption lines of the metal vapor can be studied. Spectra of copper, silver, gold, magnesium, zinc, cadmium, aluminum, tin, lead, tungsten, iron and nickel wires are studied. 3 Refs.  
Primary Keywords: Exploding Wires; Absorption Spectrum; Several Wire Metal Calculation  
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10272  
(SWITCHES, CLOSING)  
(Vacuum Gaps, Electrical)  
A LOW-INDUCTANCE CONTROLLED VACUUM SPARK GAP OPERATING AT A VOLTAGE OF 100 KV AND CURRENT OF UP TO 1.5 MA  
V.B. Ikonnikov, G.A. Richeeva and P.I. Shkurov  
Leningrad Polytechnical Institute, Leningrad, USSR  
Instruments And Experimental Techniques, Vol. 18, No. 6, pp 1798-1800 (12/1975).  
Trans. From: Priroda i Tekhnika Eksperimenta 6, 114-116 (November-December 1975)  
The construction and characteristics of a low-inductance (15 nH) controlled vacuum spark gap with a working voltage of 1-100 kV is described which commutates currents of up to 1.5 MA. The spark gap has a controllability range 1-100 kV, short actuation time delays 1-0.2 microsecond, and small values of time-delayed scatter. 9 Refs.  
Primary Keywords: Vacuum Spark Gap; 1-100 kV Operating Voltage; 1.5 MA Operating Current; Low Jitter; Three Main Electrodes  
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10273  
(ENERGY STORAGE, INDUCTIVE; ENERGY STORAGE, CAPACITIVE; SWITCHES, OPENING)  
(Systems, Capacitor Banks; Explosive Fuses)  
INDUCTIVE STORE PULSE COMPRESSION SYSTEM FOR DRIVING HIGH SPEED PLASMA IMPLSIONS  
R.E. Reinovsky, D.L. Smith, M.L. Baker, J.H. Dignan, R.P. Henderson, R.J. Kohn, D.A. Kise and M.F. Roderick  
AFWL, Kirtland AFB, NM 87117  
IEEE Transactions On Plasma Science, Vol. PS-10, No. 2, pp 73-81 (06/1982).  
The Air Force Weapons Laboratory has investigated and developed inductive pulse compression techniques with fuse opening switches for driving high speed plasma implsions. Experiments have demonstrated the delivery of 7.5 MA to a 5-nH load in <200 ns from an initial 1.9-MJ 2-microsecond capacitor bank via inductive pulse compression. Circuit considerations dictate the overall energy efficiency while MHD considerations dictate overall implsion stability and thermalization time. Theoretical considerations along with initial experiment results are presented in this paper. 11 Refs.  
Primary Keywords: Inductive Energy Store; Explosive Fuse; 7.5 MA Output Current; Capacitive Energy Store; 1.9 MJ Initial Stored Energy; Experiment; Theory  
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10274  
(BREAKDOWN STUDIES; BREAKDOWN STUDIES)  
(Gas, Electrical; Gas Arcs)  
SIMILARITY RELATIONS FOR THE ELECTRIC ARC IN FORCED AXIAL FLOW  
K. Regaller (1) and D.T. Tuma (2)  
(1) Brown, Boveri & Co Ltd, Baden, Switzerland  
(2) Carnegie Mellon University, Pittsburgh PA 15213  
IEEE Transactions On Plasma Science, Vol. PS-9, No. 2, pp 75-79 (06/1981).  
The conservation equations of mass, momentum, and energy in different form, Ohm's law, and the experimentally determined dependence of the interruption capability of the arc on current shape are employed to obtain similarity relations for high pressure electric arcs in forced axial flow around current zero. The similarity relations are then applied to assess the validity of laminar and turbulent flow models for the arc by comparing model predictions with experiment. It is found that the laminar flow model quite often predicts a behavior contrary to experiment, while the turbulent flow model predictions are much more consistent with experiment. Moreover, the similarity relations should also be useful in exploring arc behavior under circumstances not discussed in this work. 12 Refs.  
Primary Keywords: Gas Breakdown; High-pressure Arc; Arc Interruption; Axial Flow; Experiment; Theory Conservation Equations; Ohm's Law; Laminar Flow Model; Turbulent Flow Model  
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10275  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Current)  
HIGH FREQUENCY ROGOWSKI COIL RESPONSE CHARACTERISTICS  
M. Stygar and G. Gerdin  
Fusion Studies Lab, Urbana, IL 61801  
IEEE Transactions On Plasma Science, Vol. PS-10, No. 1, pp 40-44 (03/1982).  
The high frequency response characteristics of differentiating and self-integrating Rogowski coils have been calculated for arbitrary values of the coil terminating resistance assuming Ampere's law to be valid. Effects due to a reactive terminating impedance are also discussed. When the displacement current is taken into account in the measurement of the current of a charged particle beam, it is found that an effective rise time is introduced into the self-integrating coil response on the order of  $a/\gamma v$ , where  $a$  is the major radius of the coil,  $v$  is the velocity of the beam, and  $\gamma = 1/\sqrt{1 - v^2/c^2}$ . 10 Refs.  
Primary Keywords: Rogowski Coil; Response Characteristic; Frequency Response; Ampere's Law; Terminating Impedance; Current Transformer  
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10276  
(SWITCHES, OPENING; BREAKDOWN STUDIES)  
(Mechanical; Gas, Recovery)  
MECHANISMS FOR TEMPERATURE DECAY IN THE FREELY RECOVERING GAS BLAST ARC  
E. Richley and D.T. Tuma  
Carnegie Mellon University, Pittsburgh PA 15213  
IEEE Transactions On Plasma Science, Vol. PS-10, No. 1, pp 2-7 (03/1982).  
Energy loss mechanisms for the extinguished gas blast arc channel in free recovery are defined and their comparative magnitudes are explored for both  $N_2$  and  $SF_6$  gases. The arc channel temperature decay rate is found to follow at least two time constants, one corresponding to the transit time of the channel gas and the other to a later period. In addition, the influence of the gas pressure and of the initial conditions of the arc channel and the surrounding hot gas mantle on current zero on the decay rate of the channel temperature are investigated. 9 Refs.  
Primary Keywords: Gas Arc Recovery; Gas Blast Arc; Energy Loss; Nitrogen Gas;  $SF_6$  Gas; Arc Channel Temperature; Variable Gas Pressure  
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10277  
TIME-DEPENDENT ION DIODE PHYSICS AND ION BEAM TRANSPORT IN STABILIZED PLASMA CHANNELS  
F.L. Sandel  
JAYCOR Inc, Alexandria, VA 22304  
Final rept. 19 Jul 79-30 Apr 80 No. JAYCOR-PSD-200-81-001-FR, 55p (01/1981).  
Availability: AD-A098 888/1  
NTIS

This report summarizes work performed by JAYCOR which has led to significant advances in the understanding of ion diode physics as well as new knowledge of the processes of ion beam transport in the stabilized plasma channel systems previously developed by JAYCOR. The report is divided into three sections. Part A is a comprehensive study of the pinch-beam ion diode. This work was expanded considerably beyond the original scope of the contract and includes studies of anode materials, anode plasma behavior, time-dependent ion beam profiles, beam bunching, ion species and beam neutralization. Part B is a detailed analysis of plasma channel transport experiments in which previously unknown ion energy losses were discovered in the anode diode and/or focusing regions. Part C is a collection of abstracts of papers written during the period of this work.  
Primary Keywords: Plasmas(Physics); Ion Beams; Transport Properties; Channels; Stability; Pinch Effect; Diodes; Pulse Generators; Acetates; Vinyl Plastics; Electrical Impedance; Focusing; Shape  
Secondary Keywords: Gamble 1 Pulse Generators; NTISDODXA; NTISDODXA

10278  
ABSTRACTS OF THE HYDROGEN THYRATRON SYMPOSIUM (4TH), HELD AT SIGNAL CORPS ENGINEERING LABORATORY, FORT MONMOUTH, N. J., NOVEMBER 17 AND 18, 1955  
ECOM, Fort Monmouth, NJ 07703  
(01/1955).  
Availability: AD-660 279  
NTIS

Contents: Ratings and new concepts in hydrogen thyatron design; A magnetic assist to hydrogen thyatron switch tubes; A method of paralleling switch tubes for pulsed service; Design notes of high power modulators utilizing hydrogen thyatron types 5948/1754 and VC-1257; Effect of circuit parameters on hydrogen thyatron operating pressures; Contributing factors to hydrogen thyatron jitter; Clipper tube operating parameters in hydrogen thyatron modulators.  
Primary Keywords: Thyratrons; Hydrogen; Abstracts; Symposia; Design; Modulators; Performance(Engineering); Clipper Circuits; Electronic Switches; Circuits; Stability; Pulse Modulation

10279  
ACCELERATOR TECHNOLOGY PROGRAM. PROGRESS REPORT, APRIL-DECEMBER 1978  
E.A. Knapik and R. Janssen  
Los Alamos National Labs, Los Alamos, NM 87545  
(05/1980).  
Availability: LA-8350-PR  
NTIS

This report presents highlights of activities in the Accelerator Technology (AT) Division from April through December 1978. The report is divided into 10 sections to cover work done by the four groups that make up AT Division (AT-1, AT-2, AT-3, and AT-4). Section I is a brief summary of the whole report. Sections II through VI describe work done by AT-1, the Linac Technology Group. Subjects covered are the Pion Generation for Medical Irradiation Program, the Electronuclear Fuel-Producing Accelerator Program, the Gyrocon rf Amplifier Program, the Electron Linear Accelerator Program, and the Free Electron Laser Program. Section VII covers the linear Accelerator Beam Dynamics development, and Sec. VIII deals with work with the M exp - Ion Source. Most of the work in Secs. VII and VIII was done by AT-2, the Special Projects Group, although work on factors influencing emittance growth was done by MP-9, and results on emittance growth in the new European Council for Nuclear Research (CERN) linac were reported by an AT-D0/MP-9 team. Section IX concerns the Proton Storage Ring Program for which AT-3, the Storage Ring Technology Group, is responsible. Section X describes the Fusion Materials Irradiation Test (FMIT) Program. This work is done by AT-4, which was organized in April 1978 to design and supervise the construction of the FMIT accelerator. The accelerator team is composed of personnel from AT-4 and the Hanford Engineering Development Laboratory, Richland, Washington. This  
Primary Keywords: Accelerator; Accelerator Facilities; Beam Dynamics; Beam Transport; Fmit Linac; Hydrogen Ions 1 Minus; Ion Sources; Lamp Linac; Linear Accelerators; Pion Beams; Proton Beams; Quadrupoles; Research Programs; RF Systems; Storage Rings  
Secondary Keywords: ERDA/430303; NTISDE

10280  
AIRCRAFT EMP ISOLATION STUDY  
A. Finzi, H. Price, P. Cheo, S. Mercer and T. Naff  
AFML, Kirtland AFB, NM 87117  
Final rept. (07/1980).  
Availability: AD-A093 722/2  
NTIS  
This report presents the results of a preliminary study into methods for electrically isolating the E-4B, the EC-135, and the EC-130 aircraft during EMP tests where the aircraft under test is directly driven by a high-voltage pulser.  
Primary Keywords: Electronic Aircraft; Electromagnetic Pulses; Breakdown(Electronic Threshold); Test Methods; Electric Arcs; Pulse Generators; High Voltage; Aircraft; Electric Fields; Intensity; Isolation; Dielectrics; Aircraft; Landing Gear  
Secondary Keywords: EC-135 Aircraft; EC-130 Aircraft; E-4B Aircraft; Airplane E-4B; Airplane EC-135; Airplane EC-130; EMP; NTISDODXA; NTISDODAF

10281  
THE POSSIBILITY OF THE USE OF LIQUID DISCHARGERS IN HIGH-VOLTAGE NANOSECOND PULSE CIRCUITS  
G.A. Mesyats and G.A. Vorob'yev  
FTD, Wright-Patterson AFB, OH  
No. FTD-IDRS1-1511-80, 7p (11/1980).  
Availability: AD-A092 820/0  
NTIS  
No abstract available.  
Primary Keywords: Commutators; Oils; Breakdown(Electronic Threshold); Spark Gaps; Pulse Generators; Transistors; USSR  
Secondary Keywords: NTISDODXA; NTISFMR

# 10282 MODELLING OF COMPRESSED MAGNETIC FIELD GENERATORS BY EQUIVALENT CIRCUIT APPROACH

M. Jones  
Atomic Weapons Research Establishment, Aldermaston, Berkshire, UK  
No. AWRE-D-21/80, 54 (07/1980).  
Availability: AD-A091 933/2  
NTIS

An equivalent circuit model is presented for a helical compressed magnetic field generator. The emphasis has been placed on producing a model which has a short computer run time. Magnetic energy losses due to non-linear field diffusion are taken into account, together with the effects of magnetically-induced conductor motion. Examples of the computer code results are given, together with a comparison with experimental data. (Author)

Primary Keywords: Pulse Generators; Magnetic Fields; Electromagnetic Wave Propagation; Equivalent Circuits; Computerized Simulation; Helical Antennas; Pressure Transducers; Energy Conversion; Explosions; Electric Power; Magnet Coils; Input; Experimental Design  
Secondary Keywords: Foreign Technology; NTISDODXA; NTISFNUK

# 10283 THE ELECTRON BEAM SEMICONDUCTOR (EBS) AMPLIFIER

R.M. True and J.F. Baxendale  
ECOM, Fort Monmouth, NJ 07703  
Research and development technical rept. No. DELET-TR-80-13, 42p (07/1980).  
Availability: AD-A091 283/2  
NTIS

The Electron Beam Semiconductor (EBS) concept has existed for three decades, but only within the last decade has an active, well-defined program been underway to develop devices that can operate as high-power radio frequency (RF) amplifiers, fast risetime switches, and current and voltage pulse amplifiers. This report discusses the test procedures, data and results of reliability testing of RF and video EBS amplifiers at Electronics Research and Development Command (ERADCOM), Fort Monmouth, New Jersey. Also, the experimental analysis of the series-connected diode EBS device is described in detail. Finally, the report concludes with a discussion of the state-of-the-art of EBS and future trends of the technology. (Author)

Primary Keywords: Semiconductor Diodes; Current Amplifiers; Control; Electron Beams; Radiofrequency Amplifiers; Pulse Amplifiers; Radiofrequency Pulses; State Of The Art; Reliability (Electronics); Life Tests; Test Equipment; Circuit Analysis  
Secondary Keywords: NTISDODXA

# 10284 DEVICE WHICH TRIGGERS HIGH-VOLT PULSE GENERATOR

I.P. Paker  
FTD, Wright-Patterson AFB, OH  
No. FTD-ID(RS)T-1934-79, 9p (02/1980).  
Availability: AD-A090 985/3  
NTIS

No abstract available.  
Primary Keywords: Pulse Generators; Trigger Circuits; Spark Gaps; High Voltage; Fixed Capacitors; Transistors; USSR  
Secondary Keywords: Triptrons; NTISDODXA; NTISFNUK

# 10285 STAGE GENERATOR CALCULATION

I.T. Vovkisev, G.M. Skornovskiy and E.I. Ryuskiy  
Akademiya Nauk USSR, Khar'kov Fiziko-Tekhnicheskii Inst.  
(01/1979).  
Availability: KFTI-79-21  
NTIS

An engineering calculation of the cascade generator (CG) is made for the two schemes used widely in accelerating techniques, for the stable and pulse regimes of loading. The order of the CG calculation at stable loading is shown, as well as the calculation order at pulse loading for the example of the calculation of high voltage CG (70V, 0.25 A, 500 ns, 100 Hz). The calculation error is checked at the CG-300 (in operation) and at the low-voltage CG-700 model, and is 1-4% for delta U and delta I and not worse than 6% for other values. (Atomindex citation 11:508860)

Primary Keywords: Linear Accelerators; Accuracy; Design; Dimensions; Electric Conductivity; Electric Potential; High-voltage Pulse Generators; Numerical Solution; Pulses  
Secondary Keywords: IN RUSSIAN; Foreign Technology; ERDA/430300; NTISINIS; NTISFNUK  
Distribution Restriction: U.S. SALES ONLY.

# 10286 ADC DATA ACQUISITION SYSTEM FOR THE ACCELERATOR VICKSI

M. Liebl and M. Martini  
Mahn-Maitner Inst, FRG  
(07/1979).  
Availability: HMI-B-309  
NTIS

A data acquisition system for experiments with the heavy ions accelerator VICKSI uses fast ADCs with high resolution. The modular CAPAC system used transfers the desired single events in a 'Single Mode' from the ADCs to the computer, while the desired coincidence events from up to 12 ADCs are transferred in a 'Group Mode'. The undesired events are rejected by hardware. This report describes the 'Single Mode' and the 'Group Mode' together with a data check and group checks, and it describes furthermore an INPUT REGISTER allowing the ADCs to work in both modes simultaneously, as well as a DUAL SHIFT INPUT REGISTER for dual channel measurements in the 'Single Mode'. (Atomindex citation 11:505611)

Primary Keywords: Vicksi; Analog-to-digital Converters; Camac System; Coincidence Circuits; Data Acquisition Systems; Isochronous Cyclotrons; Pulse Circuits  
Secondary Keywords: IN GERMAN; Foreign Technology; ERDA/430303; NTISINIS; NTISFNUK  
Distribution Restriction: U.S. SALES ONLY.

# 10287 VECTOR-POTENTIAL FLOW IN RELATIVISTIC BEAM DIODES

D.P. Bacon, S.A. Goldstein, R. Lee and G. Cooperstein  
Naval Research Lab, Washington, DC 20375  
Memorandum rept. No. NRL-MR-4326, 38p (09/1980).  
Availability: AD-A089 135/8  
NTIS

Analytic theory, numerical simulations and experiments indicate that a combination of a bias current pinch and an ion induced pinch may allow the efficient pinching of electron beams generated in large aspect ratio diodes. In the new diode geometry, electrons flow radially inward along vector-potential field lines which lie close to the anode. As these electrons do not touch the anode, there is no plasma formation and consequent loss of energy to accelerated ions. Entering a region close to the axis in which an anode plasma does exist, these electrons undergo an ion induced pinch to still smaller radii. Since the bulk of the flow occurs along vector-potential field lines, we have coined this new diode the Paravector-potential diode. (Author)

Primary Keywords: Electron Guns; Beam Forming; Diodes; Aspect Ratio; High Voltage; Pinch Effect; Relativity Theory; Potential Flow; Vector Analysis; Bias; Pulse Generators  
Secondary Keywords: Gamble 2 Pulse Generators; NTISDODXA

# 10288 LOW JITTER SPARK GAP SWITCH FOR REPETITIVELY PULSED PARALLEL CAPACITOR BANKS

G.J. Rohwein  
Sandia Labs, Albuquerque, NM 87115  
No. CONF-800640-2, 8p (01/1980).  
Availability: SAND-80-0456C  
NTIS

A two-section air insulated spark gap has been developed for switching multi-kilojoule plus-minus charged parallel capacitor banks which operate continuously at pulse rates up to 20 pps. The switch operates with less than 2 ns jitter, recovers its dielectric strength within 2 to 5 ns and has not shown degraded performance in sequential test runs totaling over a million shots. Its estimated life with copper electrodes is > 10 exp 7 shots. All preliminary tests indicate that the switch is suitable for continuous running multi-kilojoule systems operating at least 20 pps. (ERA citation 05:029532)

Primary Keywords: Linear Accelerators; Experimental Data; Graphs; Performance; Pulse Generators; Spark Gaps; Switching Circuits  
Secondary Keywords: ERDA/430303; NTISDE

# 10289 SYNCHRONIZING THE START OF 400-KV VOLTAGE PULSE GENERATOR (GIN-400) AND MEASURING CIRCUIT DURING OSCILLOGRAPHING OF SHORT-TERM PROCESSES

M.I. Barash, I.S. Lavov and G.I. Chumakov  
FTD, Wright-Patterson AFB, OH  
No. FTD-ID(RS)T-1860-79, 14p (12/1979).  
Availability: AD-A087 879/3  
NTIS

No abstract available.  
Primary Keywords: Oscilloscopes; Electronic Scanners; Synchronization (Electronics); Transistors; USSR  
Secondary Keywords: Dual Beam Oscilloscopes; Autostart Registration; NTISDODXA; NTISFNUK

# 10290 DEVELOPMENT OF A 50 HZ, 250 KV, 500 NS, 500 KW AVERAGE POWER PULSER

M.T. Buttram  
Sandia Labs, Albuquerque, NM 87115  
No. CONF-800640-8, 6p (01/1980).  
Availability: SAND-80-0491C  
NTIS

This paper describes the development of a 50 Hz research pulser with per shot specifications of 250 kV, 500 ns FWHM, 10 kJ. It is designed for burst mode service. The pulser is a two element Guillouin Type C pulse forming network with two parallel Marx generators serving as the first element and a single Marx generator serving as the second element. This paper will consider the two Marx generators of the first element only and will outline the important ongoing developmental areas. (ERA citation 05:029534)

Primary Keywords: Accelerator Facilities; Linear Accelerators; Power Supplies; Pulse Generators; Specifications  
Secondary Keywords: ERDA/430303; NTISDE

# 10291 DESIGN AND CONSTRUCTION OF A PRECISION PULSE GENERATOR

J.C. Robles G  
Instituto Politecnico Nacional, Mexico City, Mexico  
Thesis (06/1977).  
Availability: INTS-mf-4230  
NTIS

The design and construction of a pulse generator is considered to simulate in due form and magnitude the pulses obtained in semiconductor detectors of nuclear radiation in a frequency interval to allow its use in testing and calibration of spectrometric systems. A parameters analysis which define the pulse form through the various types of semiconductor detectors was realized with the object to obtain the most important characteristics of the pulse transmitted by the generator. These are the characteristics: Variable frequency from 0.0125 to 120 Hz, variable amplitude from 0 to 1 V, Integral linearity +/- 0.25%, amplitude stability -0.031%/degC exponential going up time and variable according to steps of 0.5, 25, 60, 130 and 275 nsec, decay time constant 200 or 400 mu sec, with output ending at 100 omega. According to the results, the stability is less than the established in the design. In order to improve it, an analysis was made in function with the temperature of the components which integrate the circuit that produces the pulse. This analysis allow us to define the specifications related to the components which integrate the circuit that produces the pulse. This analysis allow us to define the specifications related to the components. Finally a compilation was made of the most common applications of the generator in nuclear instrumentation. (Atomindex citation 09:402214)

Primary Keywords: Pulse Generators; Counting Circuits; Design; Pulse Circuits; Pulse Techniques; Semiconductor Detectors  
Secondary Keywords: IN SPANISH; ERDA/440300; Mexico; NTISINIS; NTISFNUK  
Distribution Restriction: U.S. SALES ONLY.

10292  
STABILIZATION OF THE OUTPUTS OF PULSE AMPLIFIERS UTILIZING NON-LINEAR  
FEEDBACK NETWORKS. APPLICATION TO NUCLEAR SPECTROMETER AMPLIFIERS  
K.L. Manin  
CEA Centre d'Etudes Nucleaires, Serclay, France 92260  
(02/1978)  
Availability: CEA-R-4900  
NTIS

In nuclear spectroscopy, baseline instability and random fluctuations at the output of the amplifier create imperfectly solved problems mainly at high counting rates. After a critical examination of current systems, solutions are proposed which surpass existing ones. It is shown that restorers and stabilizers of baselines have their own preferential application. Considering natural limits of performance the proposed solutions give entirely satisfactory results. (Atomindex citation 10:423899)  
Primary Keywords: Pulse Amplifiers; Spectrometers; Background Noise; Feedback; Stability  
Secondary Keywords: IN FRENCH; ERDA/440103; NTISINIS; NTISFNFR  
Distribution Restriction: U.S. SALES ONLY.

10293  
PHYSICAL PRINCIPLES OF AVALANCHE TRANSISTOR PULSE CIRCUITS  
D.J. Hamilton, J. Gibbons and M. Shockley  
Stanford University, Stanford, CA 94305  
Technical rept. No. TR-53, 19p (02/1959).  
Availability: AD-213 153/0  
NTIS

No abstract available.  
Primary Keywords: Transistors; Circuits; Theory  
Secondary Keywords: Avalanche Transistors; NTISDODXD; NTISDODXB  
Distribution Restriction: DISTRIBUTION LIMITATION NOW REMOVED. NOTE: ONLY 35MM MICROFILM IS AVAILABLE. NO MICROFICHE.

10294  
PRODUCTION AND MEASUREMENT OF ULTRAHIGH-SPEED IMPULSES: IMPULSE  
BREAKDOWN IN THE 1E-9 SEC RANGE OF AIR AT ATMOSPHERIC PRESSURE  
R.C. Fletcher  
Massachusetts Institute of Technology, Cambridge, MA  
No. 42187, 10p (01/1969).  
Availability: AD-070 882/6  
NTIS

No abstract available.  
Primary Keywords: Transients; Voltage Dividers; Pulse Generators; Measurement; Oscilloscopes; Electric Discharges; Air; Barometric Pressure  
Secondary Keywords: NTISDODXD; NTISDODXB  
Distribution Restriction: DISTRIBUTION LIMITATION NOW REMOVED. NOTE: ONLY 35MM MICROFILM IS AVAILABLE. NO MICROFICHE.

10295  
NANOSECOND PULSE TECHNIQUE FOR MULTIPLE FRONT STUDIES IN SHOCK TUBES  
M.J. Lubin  
Cornell University, Ithaca, NY 14850  
(08/1963)  
Availability: AD-432 779/7  
NTIS

A technique for the production of well-defined, precisely timed nanosecond pulses of X-band microwave power is described. A system for the investigation of extremely fast electron density fronts in shock tubes is outlined utilizing the transmitted and reflected pulses generated by this technique. The transmitted and reflected pulses are displayed on a 2000-mc. rastered oscilloscope. (Author)  
Primary Keywords: Pulse Generators; Shock Tubes; Shock Tubes; Instrumentation; Timing Circuits; Oscilloscopes; Crystal Detectors; X Band; Pulse Transmitters; Velocity; Waveguides; Periodicals  
Secondary Keywords: NTISDODXD; NTISDODXB  
Distribution Restriction: DISTRIBUTION LIMITATION NOW REMOVED. NOTE: ONLY 35MM MICROFILM IS AVAILABLE. NO MICROFICHE.

10296  
THEORY OF SMALL HELICAL MAGNETIC FLUX COMPRESSION AMPLIFIERS  
O.M. Stuetzer  
Sandia Labs, Albuquerque, NM 87115  
(05/1979)  
Availability: SAND-79-1075  
NTIS

A linear theory is presented of closely wound, helical, magnetic flux compression transducers. The theory is based on an equivalent circuit model. Inductance, load resistance, and eight basic materials and design parameters are taken into account; capacitances are neglected. It was necessary to introduce two parameters which are not well understood, but it can be proven that varying them causes only minor changes in the results. The primary conclusion reached is that device performance is limited by both flux loss and flux remaining in the generator after compression. (ERA citation 05:002348)  
Primary Keywords: Flux Pumps; Pulse Generators; Analytical Solution; Electronic Circuits; Magnetic Compression; Magnetic Flux  
Secondary Keywords: ERDA/990000; NTISDE

10297  
PARALLEL-PLATE TRANSMISSION LINE TYPE OF EMP SIMULATORS: SYSTEMATIC  
REVIEW AND RECOMMENDATIONS  
D.V. Giri, T.K. Liu, F.M. Tesche and R.W.P. King  
AFWL, Kirtland AFB, NM 87117  
Final rept. No. DC-FR-1299-4, 166p (05/1980).  
Availability: AD-A586 814/1  
NTIS

This report presents various aspects of the two-parallel-plate transmission line type of EMP simulator. Much of the work is the result of research efforts conducted during the last two decades at the Air Force Weapons Laboratory, and in industries/universities as well. The principal features of individual simulator components are discussed. The report also emphasizes that it is imperative to hybridize our understanding of individual components so that we can draw meaningful conclusions of simulator performance as a whole.  
Primary Keywords: Electromagnetic Pulses; Electromagnetic Pulse Simulators; Pulse Generators; Simulators; Transmission Lines; Parallel Orientation; Plates; Van De Graaff Generators; Electrical Impedance; Electric Fields  
Secondary Keywords: EMP; EMP Generators; Conical Transmission Lines; Wave Generators; Open Structures; Wave Launchers; Corona Rings; Conical Wave Guides; Characteristic Impedance; NTISDODXA; NTISDODAF

10298  
COMPRESSED MAGNETIC FLUX AMPLIFIER WITH CAPACITIVE LOAD  
O.M. Stuetzer  
Sandia Labs, Albuquerque, NM 87115  
(03/1980).  
Availability: SAND-79-2339  
NTIS

A first-order analysis is presented for a compressed magnetic flux (CMF) current amplifier working into a load with a capacitive component. Since the purpose of the investigation was to gain a general understanding of the arrangement, a number of approximations and limitations were accepted. The inductance of the transducer varies with time; the inductance/resistance/capacitance (LRC) circuit therefore is parametric and solutions are different for the stable regime (high C), the oscillation regime (low C), and the transition case. Solutions and performance depend strongly on circuit boundary conditions, i.e., energization of the circuit by either an injected current or by an applied capacitor charge. The behavior of current and energy amplification for the various cases are discussed in detail. A number of experiments with small CMF devices showed that the first-order theory presented predicts transducer performance well in the linear regime. (ERA citation 05:023357)  
Primary Keywords: Magnetic Compression; Pulse Generators; Analytical Solution; Magnetic Flux; Power Supplies  
Secondary Keywords: ERDA/700202; NTISDE

10299  
(ELECTROMAGNETIC COMPATIBILITY)  
(Grounding And Shielding)  
DESIGNING THE RFI SHIELDED PACKAGE

A.L. Albin  
Fairchild Space and Defense Systems, Syosset, NY  
Electronic Industries, Vol. 24, No. 1, pp 80-83 (01/1965).  
The various problems of shielding electronic systems against EMI are discussed briefly in this paper. Several possible paths for EMI through shielded enclosures are identified with steps to reduce these paths suggested. Materials are discussed briefly, as are means of filtering necessary penetrations to enclosures. 6 Refs.  
Primary Keywords: Shielded Enclosures; EMI Reduction; Joint Construction; Materials Consideration; Penetrations; Power Filtering  
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10300  
(SWITCHES, OPENING)  
(Explosive Fuses)  
A POWERFUL FOIL BREAKER FOR A CURRENT OF 0.5 MA, WHICH ACTUATES IN 5  
MICROSECONDS  
L.V. Dubovoi, I.M. Reife, E.V. Sorodenko and B.A. Stekol'nikov  
Scientific-Research Institute Of Electro-Physical Equipment, Leningrad, USSR  
Instruments And Experimental Techniques, Vol. 17, No. 2, pp 421-422  
(04/1974).  
Trans. From: Priory i Tekhnika Eksperimenta 1, 107-108 (March-April 1974)

The construction and electrical characteristics of a breaker for a current of up to 0.5 MA are considered; the breaker is based on current heating followed by thermal explosion of a metallic foil in quartz sand. For a time 1/4-50 microseconds of current rise to the maximum value, actuation of the breaker takes place in approximately 5 microseconds. 2 Refs.  
Primary Keywords: Opening Switch; Exploding Foil; Quartz Sand Environment; 5 Microsecond Opening Time; 500 kA Current  
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10301  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
ENERGY PARTITION IN THE EXPLODING WIRE PHENOMENA  
F.D. Bennett  
Army Research and Development Command, Aberdeen Proving Ground, MD 21005  
The Physics Of Fluids, Vol. 1, No. 6, pp 515-522 (12/1958).  
Streak camera and oscillographic circuit-damping data are presented for exploded copper wires varying in diameter from 3 to 8 mils. A maximum of specific shock-wave energy in the induced flow is found at a wire diameter different from that of a minimum in the total damping time of the circuit. This displacement is shown to be caused by the presence of residual circuit resistance. The proof is based on a critical analysis of optimum damping conditions in the exploding wire circuit. A maximum of apparent energy within the contact surface appears at about the same wire diameter as the minimum of total damping time. Discussion of the implications of the Taylor-Lin similarity theory indicates that lack of similarity of the flow is probably connected with the displacement of the maximum energies associated with shock-wave and contact surface. 6 Refs.  
Primary Keywords: Exploding Wires; Copper Wires; Photographic Diagnostic; Streak Camera; Shock Wave; Wave Damping  
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10305  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
PRODUCTS FROM THE ELECTRICAL EXPLOSION OF TUNGSTEN AT CURRENTS OF  
APPROXIMATELY 1E11 A/5Q.M.  
S.V. Lebedev, B.V. Lukin, A.E. Reutsov and A.I. Savvatimskii  
Academy of Sciences of the USSR, Moscow, USSR  
High Temperature, Vol. 7, No. 5, pp 951-952 (10/1969).  
Trans. From: Teplofizika Vysokikh Temperatur 7, 1020-1021 (September-October 1969)

The products give information on the explosion mechanism for a metal subjected to a large current. The usual view is that the conductor (usually a wire) evaporates and acquires the properties of a gas, but evaporation cannot explain some results, and it has been supposed that the molten wire at 5E10 A/5Q.M. does not evaporate but breaks up into particles whose size is less than the electron mean free path in the metal. More recent results are of interest here, which indicate that explosion of a wire in air or an inert gas produces an aerosol with particles of size around 0.01 micron. The yield of this aerosol is close to 100% if the supply voltage is high enough, and the size spread of the particles is fairly narrow. Unfortunately, the explosions were not fully characterized; in particular, the current and the energy deposited in the metal were not known, nor was it established what stage in the explosion must be attained in order to produce an aerosol. 3 Refs.  
Primary Keywords: Exploding Wire; Tungsten Wire; Aerosol Production; 0.01 Micron Particle Size; 1E11 A/5Q.M. Current Density  
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10306

**(BREAKDOWN STUDIES)**  
**(Surface Flashover)****SURFACE BREAKDOWN IN VACUUM ON BARIUM TITANATE**S.P. Bugayev, V.V. Kramev, Yu.I. Tarant'ev, V.G. Shepk and Ya.Ya. Yurike  
Tomsk Polytechnic Institute, Tomsk, USSR  
Soviet Physics-Technical Physics, Vol. 16, No. 9, pp 1547-1551  
(1972).

Trans. From: Zhurnal Tekhnicheskoi Fiziki 41, 1958-1962 (September 1971)

Breakdown in vacuum at the surface of a high-permittivity dielectric is studied using high-voltage nanosecond pulse technology, high-speed photography, and observation of the glow spectrum. The discharge is initiated by vaporization of the dielectric under electron bombardment from a cathode. Spectra lines of the dielectric and electrode materials are found in the resulting plasma. The emission edge of the discharge propagates with a velocity of  $1.7 \text{ cm/sec}$ . The current increases as a result of the charging of a dynamic condenser, one of whose plates is the plasma formed on the surface of the dielectric. 8 Refs.

Primary Keywords: Surface Flashover; High-permittivity Dielectric; Barium Titanate; Photographic Diagnostic; Spectrographic Diagnostic; Discharge Propagation Velocity; Dynamic Capacitor

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10309

**(SWITCHES, CLOSING; BREAKDOWN STUDIES)****(Surface Discharge, Electrical; Surface Flashover)****X RADIATION OF A NANOSECOND GRAZING DISCHARGE IN A GAS**

P.N. Doshuk and S.L. Kulakov

M.I. Kalinin Leningrad Polytechnical Institute, Leningrad, USSR  
Soviet Technical Physics Letters, Vol. 5, No. 1, pp 26-27 (01/1979).

Trans. From: Zhurnal Tekhnicheskoi Fiziki 5, 69-75 (January 1979).  
The grazing discharge is continuously finding new applications, for example, in high-current switches, pulsed light sources, and high-power gas lasers. The grazing discharge which occurs along the interface between a gaseous dielectric and a thin solid dielectric, one side of which is metallized, typically grows to a considerable length, 1-5-100 cm, at a modest discharge voltage. A calculation of the electric field at the head of the discharge shows that both the normal and tangential components of the field with respect to the surface of the dielectric can have values approximately  $1.5-1.6 \text{ V/cm}$  as the discharge propagates. These fields correspond to the typical dielectric thickness of the head of 2 mm, and pulsed voltages of 50-100 kV. In this letter we report the first experimental demonstration that high-energy electrons are present. These electrons are generated at the head of the discharge because of the strong electric fields and the high longitudinal gradients in the discharge channel at the end of the discharge. The presence of these electrons is inferred from the x rays emitted from the grazing discharge. 11 Refs.

Primary Keywords: Grazing Discharge; E-field Calculations; Experiment; High-energy Electron; X-ray Diagnostic

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10310

**JOINT ELECTRON BEAM COMMONALITY EXPERIMENTS ON BLACKJACK 3 AND 3 PRIME: PART I. MACHINE CHARACTERIZATIONS**

D.V. Keller, A.J. Watts, D.A. Rice and J.J. Powe

Ktech Corp., Albuquerque, NM

Final rept. 1 Jan-31 Dec 79 No. KTECH-TR-79-11-PT-1, 240p (12/1979).

Availability: AD-A090 140/5

NTIS

As part of the DNA Commonality program, material stress generation experiments were performed using the pulsed relativistic electron beam from the Maxwell Laboratories' Blackjack-3 and -3 Prime electron beam machines. Materials used were solid aluminum and tantalum, each of sufficient thickness to be opaque to the beams. The induced stress histories were monitored using X-cut quartz gauges, carbon gauges, and laser velocity interferometry. Fluence levels of up to  $150 \text{ cal/cm}^2$  were used, giving deposition of up to  $750 \text{ cal/g}$ , and the deposition time was varied from 30 to 35 ns. The electron beam characterization included measurement of fluences as a function of axial and radial positions relative to the anodes, analysis of machine performance (voltage, current) to give electron energy spectra, and establishment of electron angles of incidence by comparison of Monte Carlo computations with experimental dose-depth measurements. The observed stresses and electron beam parameters are to be analyzed by SRI for comparison with their wave propagation codes. The stress pulse shapes and amplitudes agree well with nominal predictions, except that a high amplitude stress tail was observed on the high dose experiments that produced Ta vapor. (Author)

Primary Keywords: Thermal Stresses; Electron Beams; Tantalum; Aluminum; Bulk Materials; Stress Analysis; Strain Gauges; Electromagnetic Pulses; Pulse Generators; Prompt-gamma measurements; Energy Transfer; Electron Beams

Secondary Keywords: Blackjack Generators; Blackjack 3 Generators; NTISDODXA; NTISDODSD

10311

**ANALYSIS OF PROTON TRANSPORT EXPERIMENTS**

F.C. Young, S.J. Stephanakis, G. Cooperstein, D. Mosher and F.L. Sandel

Naval Research Lab, Washington, DC 20375

Memorandum rept. (09/1980).

Availability: AD-A088 905/5

NTIS

As a part of the NRL light ion beam research program, experiments on the transport of intense pulsed proton beams have been carried out. The NRL GAMBLE II pulser was used to generate proton beams and the measurement of prompt-gamma rays was the primary diagnostic for proton transport. The first sequence of shots was made using a large-diameter (4.5 cm) transport channel with a 2.5-cm diameter aperture. The transport of 1-MeV proton beams of a few hundred kilocoulombs a distance of one meter with efficiencies approaching 100% was achieved in this channel. A second sequence of shots with a smaller-diameter (1.6 cm) channel with a 1.2-cm diameter aperture was much less efficient in transporting the beam. Analysis of the prompt-gamma measurements to determine proton currents in the transport channel and transport efficiencies is presented in this report.

Primary Keywords: Proton Beams; Transport Properties; Pulse Generators; Focusing; Pinch Effect; Channels; Plasma Diagnostics; Bremsstrahlung; Low Loss; Detectors; Data Reduction; Graphs

Secondary Keywords: Gamble 2 Pulse Generators; Prompt Gamma Rays; NTISDODXA; NTISNRL

10312

**TWCP ELECTRON BEAM TESTING PROGRAM: VOLUME IV. TWCP ELECTRON BEAM TESTS**

F.A. Bick

Effects Technology Inc, Santa Barbara, CA

Final rept. Jul 77-Dec 78 No. ETI-CR-79-610-VOL-4, 134p (04/1979).

Availability: AD-A086 214/4

NTIS

This volume presents impulse and stress generation data on FM5822A tape wrapped carbon phenolic and 91-LD phenolic resin using the techniques described in Volumes I and III. Preliminary data analysis is presented, however, the final utility of these data is to be determined through the TWCP Correlation Program. Data were generated at a peak electron energy of approximately 1-MeV and at fluence levels ranging from approximately 70 to 120  $\text{cal/cm}^2$ . By a unique in situ diagnostic technique, the experimental errors associated with the beam parameters (fluence, peak dose) were approximately halved when compared with prior test programs for this type of facility.

Primary Keywords: Carbon Phenolic Materials; Composite Structures; Tape Wound Construction; Heat Shields; Electron Beams; Pulse Generators; Test Facilities; Impulse Loading; Stress Testing; Measurement; Phenolic Plastics; Hardened Structures; Weapons Effects

Secondary Keywords: NHEP(Nuclear Hardness Evaluation Procedures); Blackjack 3 Generator; NTISDODXA; NTISDODSD

10313

**TWCP ELECTRON BEAM TESTING PROGRAM: VOLUME I. SUMMARY**

F.A. Bick

Effects Technology Inc, Santa Barbara, CA

Final rept. Jul 77-Dec 78 No. ETI-CR-79-610-VOL-1, 72p (04/1979).

Availability: AD-A086 211/0

NTIS

Volume I of four volumes. Summarizes the results of a series of electron beam tests that: (1) characterized the Maxwell Laboratory's Blackjack III pulsed electron beam facility for material response studies related to nuclear weapons effects on reentry vehicle heat-shield materials; (2) developed a set of instrumentation to diagnose the electron beam environment and measure material response as to impulse and stress generation, and (3) generated impulse and stress data on FM5822A carbon phenolic and 91-LD phenolic resin materials. The data generated demonstrated the utility of the Blackjack III facility and will be used in a separate program entitled, "TWCP Correlation Program." The instrumentation developed are applicable to these types of tests on a variety of facilities. The environmental diagnostic instrumentation achieved a significant reduction in experimental uncertainties when compared to prior techniques. This program was conducted within the framework of the Nuclear Hardness Evaluation Procedures Program and the concepts developed therein. (Author)

Primary Keywords: Carbon Phenolic Materials; Composite Structures; Tape Wound Construction; Heat Shields; Electron Beams; Pulse Generators; Test Facilities; Impulse Loading; Stress Testing; Measurement; Phenolic Plastics; Hardened Structures; Weapons Effects

Secondary Keywords: NHEP(Nuclear Hardness Evaluation Procedures); Blackjack 3 Generator; NTISDODXA; NTISDODSD

10314

**FOUR-CHANNEL DELAY GENERATOR MODEL 5740**

D. Baumetz and M. Milner

Israel Atomic Energy Commission, Beerseba, Israel

(01/1978).

Availability: NRCN(ID) J18

NTIS

The 4-channel delay generator model 5740 generates 4-pulse groups in independent channels. The device offers the possibility of controlling both the time intervals between the pulses of a group and the rate of generation of groups. (Atomindex citation 10:433933)  
Primary Keywords: Pulse Generators; Delay Circuits; Design; Operation  
Secondary Keywords: IN HEBREW; ERDA/440300; NTISINIS; NTISFNIS  
Distribution Restriction: U.S. SALES ONLY.

10315

**SHAPER-AMPLIFIER FOR DRIFT CHAMBERS**

S.G. Basiladze and L. Lekhonyak

Joint Inst. for Nuclear Research, Dubna (USSR), Lab. of High Energy.

(01/1978).

Availability: JINR-13-11277

NTIS

A shaper-amplifier for drift chambers differing from the prototypes by higher sensitivity, introduction of input impulse differentiation, lesser power consumption and the number of elements is described. The shaper-amplifier containing four identical channels is built on the basis of the integral scheme of the K50LP16 "differential receiver". The scheme parameters are the following: input resistance - 300 ohms; threshold -  $1.9 \text{ nA}$ ; inherent "walking" from the current oscillator - 3.8 ns; intake power - 400 mW/channel. (Atomindex citation 10:441924)

Primary Keywords: Drift Chambers; Diagrams; Pulse Amplifiers; Pulse Shapers; Specifications

Secondary Keywords: IN RUSSIAN; Foreign Technology; ERDA/440104;

ERDA/440300; NTISINIS; NTISFNUR

Distribution Restriction: U.S. SALES ONLY.

10316

**HIGH-VOLTAGE PULSE GENERATOR WITH A PROTECTIVE SOLENOID**

V.D. Volynin, N.S. Glagoleva, N.I. Kaminskii, A.I. Matyushin and V.T. Matyushin

Joint Inst. for Nuclear Research, Dubna (USSR), Lab. of Computing

Techniques and Automation.

(01/1977).

Availability: JINR-R-13-10599

NTIS

A pulse generator with a solenoid for protection of condensators from pulse overvoltages is suggested. The protective solenoid is a part of the generator circuit assembled according to the Arkadiev-Marx scheme and it encircles the generator along its length. Besides implementing the basic protective function the solenoid can serve as a radiator with the increased area of heat dissipation in contrast to small surface resistors. The generator is used in the feed system of the JINR 2m streamer chamber and is designed for the output voltage of approximately 600 kV. (Atomindex citation 10:442045)

Primary Keywords: High-voltage Pulse Generators; Diagrams; Equivalent Circuits; Solenoids; Specifications

Secondary Keywords: IN RUSSIAN; Foreign Technology; ERDA/440300; NTISINIS; NTISFNUR

Distribution Restriction: U.S. SALES ONLY.



10317 PRELIMINARY RESULTS OF EXPERIMENTS WITH MODERATE POWER REB  
V.K. Ronggi, S.R. Iyengar and K.C. Mittal  
Shabho Atomic Research Centre, Bombay, India  
(01/1978).  
Availability: INIS-mf-4833  
NTIS  
No abstract available. (Atomindex citation 10:443085)  
Primary Keywords: Plasma Heating; Electron Beams; Pulse Circuits;  
Pulse Generators; Uses  
Secondary Keywords: Foreign Technology; ERDA/700101; NTISINIS; NTISFNM  
Distribution Restriction: U.S. SALES ONLY.

10318 GENERATION OF HIGH VOLTAGE PULSES FROM INDUCTIVE ENERGY STORES BY THE  
USE OF EXPLODING WIRES  
U. Schwarz  
Technische Univ. Braunschweig (Germany, F.R.). Fakultät fuer  
Maschinenbau und Elektrotechnik.  
(01/1977).  
Availability: HP-23910  
NTIS  
This thesis presents investigations and considerations on the  
generation of high voltages from inductive energy stores charged by a  
dc power supply. For the proposed method of voltage generation  
storage coils are needed which can bear high voltages. Design  
criteria for cylindrical coils for the use at room temperature are  
given, which show that these coils can withstand voltages of several  
100 kV even if geometrically designed for high energy content. To  
minimize the power for charging of such a coil it helps to make the  
inner ohmic resistance of the dc power source lower than the ohmic  
resistance of the coil. The discussion of the feasibility of the  
proposed system shows that it becomes useful when using a storage  
coil with a total volume of more than 1 m exp 3. Such coils can be  
built for high voltages and can be charged with a power of some 100  
kW to an energy content up in the MWh-range. Finally two possible  
applications are described, one with an ohmic load and one with a  
capacitive load. (ERA citation 04:057003)  
Primary Keywords: High-voltage Pulse Generators; Design; Exploding  
Wires; Feasibility Studies; Induction; Performance;  
Pulse  
Secondary Keywords: IN GERMAN; ERDA/420200; ERDA/420800; Theses;  
NTISDEP; NTISFNGE  
Distribution Restriction: U.S. SALES ONLY.

10319 EXPLOSIVE MHD RESEARCH  
S.P. Gill, D.W. Baum, W.L. Shimmin and D. Mukherjee  
Artec Associates Inc, Hayward, CA  
Final rept. 1 Apr 76; 11 Mar 77. No. FR-119, 125p (05/1977).  
Availability: AD-A079 551/8  
NTIS  
Research on dense nonideal plasmas used in explosive MHD pulse  
power generators is described. Experiments were performed with three  
types of explosive plasma sources producing a plasma pressure about  
10 kbar and a plasma temperature about 5 eV (58,000 K). A literature  
survey was performed on theoretical methods for predicting the  
properties of nonideal plasmas, and calculations were performed using  
some of the models. Encouraging progress was made in reducing a  
discrepancy between theory and experiment. (Author)  
Primary Keywords: Magnetohydrodynamic Generators;  
Magnetohydrodynamics; Explosive Forming; Plasma  
Devices; Energy Conversion; Pulse Generators;  
Compression; Shock Waves; Experimental Data  
Secondary Keywords: Debye Huckel Theory; Chapman Enskog Integrals;  
NTISDODXA

10320 CALCULATIONS OF THE PERFORMANCE OF EXPLOSIVE IMPULSE GENERATORS  
M.M. McKay and R.M. Schlaug  
Army Amament Research and Development Command, Aberdeen Proving Ground,  
MD 21005  
Final rept. No. SAI-78-919-LJ, 42p (08/1979).  
Availability: AD-A079 408/1  
NTIS  
Numerical calculations of the performance of explosive impulse  
generators were performed. The explosive impulse generators were  
intended to provide the guidance thrust for a fast response missile  
guidance system. The objective of the calculations was to provide  
information to help determine whether an explosive impulse generator  
could be designed to produce the required impulse without generating  
a stress environment within the vehicle body that could cause damage  
either to the internal electronics or to the remaining undetonated  
impulse generators. Several 1D finite difference calculations were  
performed to analyze various buffering or stress attenuation schemes  
while at the same time estimating the impulse generated by the  
explosive thruster systems. The 1D analyses show that it may be  
possible to design a system with the required features but further  
analysis involving 2D explosive loading/structural response  
calculations is required. (Author)  
Primary Keywords: High Explosives; PETN; Sheet Explosives; Pulse  
Generators; Finite Difference Theory; Thrust;  
Loads/Forces; Numerical Analysis; Shock Waves;  
Attenuation; Stresses; Guided Missile Components;  
Structural Response; One Dimensional; Two Dimensional  
Secondary Keywords: Impulse Generators; Explosive Loading; Design; Air  
Gases; NTISDODXA; NTISDODA

10321 SMALL HELICAL FLUX COMPRESSION AMPLIFIERS  
J.E. Gover, O.M. Stuetzer and J.L. Johnson  
Sandia Labs, Albuquerque, NM 87115  
No. CONF-790540-2, 33p (01/1979)  
Availability: SAND-79-1084C  
NTIS  
Small, explosively compressed, magnetic flux transducers with many  
closely spaced helical turns are investigated theoretically and  
experimentally. The analysis is limited to linear operation, but  
takes into account load influence, proximity effects, and switching  
delays. The latter are due to retarded breakdown in the wire  
insulation and to the finite decay time of the magnetic field in the  
wire. More than 150 experiments showed considerable data scatter.  
Shots which exhibited low clocking and high amplification were in  
good agreement with the theory. The main conclusion is that device  
performance is limited not only by flux loss, but by flux remaining  
in the generator after compression. (ERA citation 04:052370)  
Primary Keywords: Amplifiers; Power Supplies; Thermomagnetic Reactors;  
Explosions; Inertial Confinement; Magnet Coils;  
Magnetic Compression; Magnetic Flux; Pulse  
Generators; Switches  
Secondary Keywords: ERDA/700203; ERDA/700208; NTISIDE

10322 GENERATOR OF CURRENT PULSES WITH AN AMPLITUDE OF 166 A AND STABILITY OF  
+OR- 1E-3 AT A REPETITION RATE OF 2 HZ  
B.F. Bayanov, A.V. Il'in, V.M. Pakin, A.P. Panov and G.I.  
Sill'vestrov  
FTD, Wright-Patterson AFB, OH  
No. FTD-TR(5)T-0110-79, 17p (02/1979).  
Trans. From: Uskoryitel'nyy Zaryazhenyykh Chestits 1, pp 283-286 (1978)  
By G.S. Mack  
Availability: AD-A075 180/0  
NTIS  
No abstract available.  
Primary Keywords: Pulse Generators; High Power; Pulse Rate; Repetition  
Rate; Stability; Circuit Analysis; Translations  
Secondary Keywords: NTISDODXA; NTISFNMUR

10323 PULSER FOR VERTICALLY POLARIZED DIPOLE FACILITY (VPD-II)  
Authors Unknown  
AFWL, Kirtland AFB, NM 87117  
Final rept. No. PIFR-900, 82p (07/1979).  
Availability: AD-A074 838/4  
NTIS  
This report will provide an outline of the pulser system design  
features and will give an account of both the factory and site  
acceptance test procedures and results. During the testing periods  
certain modifications were found to be necessary in order to improve  
the performance. These modifications are described. Ultimately, a  
performance limitation was realized when the pulser was operated into  
the full VPD-II antenna structure, a limitation which could not be  
removed without a major redesign of the output peaking circuit. This  
will be discussed in the report summary and some tentative  
suggestions for a future upgrading will be offered.  
Primary Keywords: Pulse Generators; Electromagnetic Pulse Simulators;  
Test Equipment; Test Facilities; Dipole Antennas;  
Systems Engineering; Modification; Acceptance Tests  
Secondary Keywords: Marx Generators; NTISDODXA; NTISDODAF

10324 VERY FAST, HIGH PEAK-POWER, PLANAR TRIODE AMPLIFIERS FOR DRIVING  
OPTICAL GATES  
M.M. Howland, S.J. Davis and M.L. Gagne  
Lawrence Livermore Lab, Livermore, CA 94550  
(06/1979).  
Availability: UCRL-82538  
NTIS  
Recent extensions of the peak power capabilities of planar triodes  
have made possible the letter's use as very fast pulse amplifiers, to  
drive optical gates within high-power Nd:glass laser chains. These  
pulse amplifiers switch voltages in the 20 kV range with rise times  
of a few nanoseconds, into crystal optical gates that are essentially  
capacitive loads. This paper describes a simplified procedure for  
designing these pulse amplifiers. It further outlines the use of  
bridged-T constant resistance networks to transform load capacitance  
into pure resistance, independent of frequency. (ERA citation  
04:047992)  
Primary Keywords: Pulse Amplifiers; Neodymium Lasers; Design;  
Performance; Power Supplies; Triode Tubes  
Secondary Keywords: ERDA/700208; ERDA/700203; Neodymium Glass Lasers;  
Planar Devices; NTISDE

10325 COMPRESSED MAGNETIC FIELD GENERATOR SYSTEMS MODEL  
J.E. Gover  
Sandia Labs, Albuquerque, NM 87115  
No. CONF-790622-5, 8p (01/1979).  
Availability: SAND-79-1204C  
NTIS  
A model relating the volume of a compressed magnetic field  
generator pulsed power system to its electrical energy output is  
developed. This systems model includes energy density and/or power  
density models of the electronic components and a CMF generator model  
which has been confirmed experimentally for system output energies up  
to 5000 J. For a given output energy there exists an optimum  
selection of the pulsed power components to give an overall minimum  
system volume. Under optimum conditions the volume of the CMF  
generator is equal to one-half of the overall system volume and the  
overall system volume increases with the one-half power of the  
systems output energy. In an all electronic system there is a linear  
relationship between system volume and output energy. (ERA citation  
04:047355)  
Primary Keywords: Electric Generators; Chemical Explosives; Design;  
Magnetic Compression; Mathematical Models;  
Performance; Pulses  
Secondary Keywords: ERDA/420200; Generators; Magnetic Fields; Pulse  
Generators; NTISDE

10326 (BREAKDOWN STUDIES)  
(Grazing Discharge)  
MEASUREMENT OF THE GAS TEMPERATURE AND ELECTRON DENSITY IN AN  
'INCOMPLETE' GRAZING DISCHARGE  
P.N. Dashuk, A.K. Zinchenko, T.G. Merkulova and E.A. Sergeenkov  
M.I. Kalinin Leningrad Polytechnical Institute, Leningrad, USSR  
Soviet Physics Technical Physics, Vol. 23, No. 8, pp 913-915 (08/1978).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 48, 1613-1616 (August 1978)  
The gas temperature in the channel in the 'incomplete' stage of a  
grazing discharge in air and SF<sub>6</sub> at 6/ is determined from the  
measured intensity distribution of the components of the resolved  
rotational structure of the bands of the second positive system of  
nitrogen over a broad temperature range. The electron density is  
determined by the Stark broadening of the H alpha line. The  
equilibrium of a grazing discharge in its incomplete stage is  
discussed on the basis of these measurements and the Saha equation.  
10 Refs.  
Primary Keywords: Grazing Discharge; Incomplete Discharge; Nitrogen  
Gas; Optical Spectroscopy; Saha Equation  
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PERMISSION

10327  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Voltage)  
A DIVIDER FOR MEASURING NANOSECOND EMT PULSES  
Y.M. Arkatov, P.I. Vatsel, V.I. Voloshchuk, E.A. Gavrilichev, V.A. Zolienko and I.M. Prokhorov  
Instruments And Experimental Techniques, Vol. 23, No. 1, pp 123-124 (04/1981)  
Trans. From: Pribury i Tekhnika Eksperimenta, No.1, pp. 123-126  
A description is given of a voltage divider in which the low-voltage arm is composed of a planar capacitor and a divider composed of MLI resistors. The divider with a division factor of 6.4E-3 provides for transmission of the leading edge of a pulse of duration a few nanoseconds and can be used in the measurement of amplitudes up to 250 kV. 4 Refs.  
Primary Keywords: Capacitive Voltage Divider; Resistive Voltage Divider; 250 kV Working Voltage; Nanosecond Rise Time; MLI Resistor  
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10328  
(PULSE GENERATORS; POWER CONDITIONING)  
(Marx; Pulse Transformers)  
A HIGH-VOLTAGE PULSE GENERATOR WITH AN EXTENDED ZONE OF STABLE OPERATION  
A.P. Komarov, Yu.P. Pichugin and I.N. Romanenko  
Chuvash State University, USSR  
Instruments And Experimental Techniques, Vol. 24, No. 2, pp 419-421 (04/1981)  
Trans. From: Pribury i Tekhnika Eksperimenta 2, 124-126 (March-April 1981)  
A generator of high-voltage pulses in the nanosecond range is described in which the stages of the dischargers are triggered by means of pulse transformers. The amplitude of the output voltage pulse is approximately 100 kV, the rise time is  $\tau_{\text{sub}}/r \ll 8$  nsec, and the recurrence rate of the pulses is up to 50 Hz. 6 Refs.  
Primary Keywords: Marx Generator; 100 kV Output Voltage; 8 ns Rise Time; Pulse Transformer Triggering; Rep-rated: 50 Hz Repetition Rate  
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10329  
(BREAKDOWN STUDIES)  
(Vacuum; Electrical)  
COMPOSITION OF THE INTERELECTRODE PREBREAKDOWN CURRENT IN HIGH VACUUM  
H.C. Bourne Jr.  
Massachusetts Institute of Technology, Cambridge, MA  
Journal Of Applied Physics, Vol. 26, No. 5, pp 625-626 (05/1955)  
Thermal rise measurements on vacuum-insulated electrodes subjected to steady gap voltages in the range of 80 to 100 kV show that the interelectrode prebreakdown current is composed chiefly to negatively charged particles. With aluminum electrodes the negative particles outnumber the positive particles (ions) by at least 300 to 1. With steel electrodes, the ratio is greater than 1000 to 1. 4 Refs.  
Primary Keywords: Vacuum Breakdown; Prebreakdown Current; DC Voltage; 100 kV Voltage; Charge Carrier Identification  
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10330  
(SWITCHES; CLOSING; SWITCHES; CLOSING)  
(Gas Gaps; Electrical; Gas Gaps; Materials)  
GAS MIXTURE  $N_2$  SUB 2 +  $SF_6$  SUB 6 / + AR FOR A HIGH-PRESSURE DISCHARGER  
B.M. Kovalevich, V.A. Lavrinovich, Yu.F. Potapitsyn and V.V. Topolyn  
Academy of Sciences of the USSR, Tomsk, USSR  
Instruments And Experimental Techniques, Vol. 22, No. 2, pp 434-436 (04/1979)  
Trans. From: Pribury i Tekhnika Eksperimenta 2, 135-137 (March-April 1979)  
The influence of the composition of a  $N_2$  sub 2 +  $SF_6$  sub 6 / + Ar gas mixture at a pressure of 0.8 atm on the commutation characteristic and actuation delay time of an eight-channel controllable discharger is investigated. The optimal mixture composition of 80%  $N_2$  sub 2 + 10%  $SF_6$  sub 6 / + 10% Ar is found which will assure maximum steepness of the voltage drop at the discharger. The actuation delay time of the discharger as a function of the gas mixture composition and a comparison between the obtained and computed commutation times are presented for single-channel commutation. 6 Refs.  
Primary Keywords: High Pressure Spark Gap; Argon Gas; Nitrogen Gas;  $SF_6$  sub 6 / Gas; Gas Mixture Optimization; 10 atm Pressure; Delay Measurement; Theory; Experiment  
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10331  
(ENERGY STORAGE; CAPACITIVE; PULSE GENERATORS)  
(Capacitor Banks; Capacitor Banks)  
GENERATION OF UNIPOLAR CURRENT PULSES OF 10 TO 100 KA AMPLITUDE  
S.L. Zelenits, N.M. Nikolaevskaya and G.A. Shneerson  
Leningrad Polytechnical Institute, Leningrad, USSR  
Instruments And Experimental Techniques, No. 3, pp 1146-1151 (10/1963)  
Trans. From: Pribury i Tekhnika Eksperimenta 5, 123-128 (September-October 1963)  
The design of a circuit is given which produces a unipolar current pulse by connecting a nonlinear resistance into the discharge circuit of a bank of capacitors with an inductive load. The nonlinear resistance may be one of the commercially produced carborundum resistors of the 'wulvite', 'tervite' or 'tyrite' type. The calculated results make it possible to select for an arbitrary tuned circuit a resistance which ensures the generation of a current pulse with a preset loss of its initial amplitude. Results are given of experimental tests conducted with the circuit at current pulses exceeding 100 kA with series and parallel connections of wulvite discs. It has been established that wulvite discs are capable of prolonged operation at current densities of up to 1 to 1.3 kA/sq.cm. (duration of the pulse is 4 to 6 microseconds), and that to increase their current-carrying capacity they may be connected in parallel. 2 Refs.  
Primary Keywords: Capacitor Banks; Unipolar Output; Inductive Load; Nonlinear Resistor; Parallel Resistors; 100 kA Current  
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10333  
(PULSE GENERATORS; POWER CONDITIONING)  
(Trigger; Pulse Forming Lines)  
HIGH-VOLTAGE PULSE GENERATOR FOR A LOW-RESISTANCE LOAD  
A.Yu. Ushakov  
Leningrad Polytechnical Institute, Leningrad, USSR  
Instruments And Experimental Techniques, Vol. 24, No. 4, pp 962-964 (08/1981)  
Trans. From: Pribury i Tekhnika Eksperimenta 4, 131-132 (July-August 1981)  
A generator is described for the production of rectangular voltage pulses with an amplitude of 1E2 to 4E3 V in a load of approximately 2 ohm. The unregulated duration of the pulses is 0.25 microseconds and their repetition rate can be varied from 1 to 100 Hz. 1 Refs.  
Primary Keywords: Pulse Generators; Pulse Forming Line; Spark Gap Switch; 1 kA Output Current; 1/2 sec Test  
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10334  
(PULSE GENERATORS)  
(Marx)  
OUTPUT PERFORMANCE OF THE COAXIAL-TYPE MARX GENERATOR CONSISTING OF  $8BaTiO_3$  SUB 3 / SERIES CERAMIC CAPACITORS  
T. Ogura (1), F. Kannari (1), M. Obara (1), T. Fujioka (1), K. Toyoda (2) and S. Nanba (2)  
(1) Keio University, Kohoku-ku, Yokohama-shi, Japan  
(2) The Institute Of Physical And Chemical Research, Wako-shi, Saitama, Japan  
The Review Of Scientific Instruments, Vol. 52, No. 2, pp 273-275 (02/1981)  
We have theoretically analyzed the output performance of the coaxial-type Marx generator consisting of  $8BaTiO_3$  sub 3 / series ceramic capacitors. In this analysis, the capacitance of the  $8BaTiO_3$  sub 3 / series ceramic capacitor has been considered to be variable with applied voltage. The results were compared with experimental results, and fairly good agreement was obtained. As a result of this analysis, it was clarified that the  $8BaTiO_3$  sub 3 / series capacitor was not able to store efficiently the electrical energy when charged at high voltages. On the other hand, the  $8SrTiO_3$  sub 3 / series ceramic capacitor has an almost constant capacitance against applied voltages, so that stored energy may be extracted efficiently. We have quantitatively revealed the superiority of  $8SrTiO_3$  sub 3 / series ceramic capacitors over  $8BaTiO_3$  sub 3 / capacitors. 2 Refs.  
Primary Keywords: Coaxial Marx Generator; Ceramic Capacitor; Capacitance Variation vs Voltage; Theory; Performance Analysis; Comparison With Experiment  
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10335  
(PULSE GENERATORS)  
(Systems)  
STEPPED HIGH-VOLTAGE PULSE GENERATOR  
Yu.M. Muzovibat'ko, P.A. Danchenko and A.G. Reznichenko  
Instruments And Experimental Techniques, Vol. 24, No. 1, pp 127-129 (02/1981)  
Trans. From: Pribury i Tekhnika Eksperimenta 1, 122-124 (January-February 1981)  
The generator described in the paper produces stepped high-voltage pulses for sweeping the trajectories of probing beams of atomic particles in plasma. The impulse consists of 10 voltage steps whose maximum duration is 1 msec with a leading edge duration of  $\leq 1.5$  microseconds. The maximum pulse amplitude is 10 kV. The irregularity of the plateau of the last step does not exceed 0.2%. 3 Refs.  
Primary Keywords: Stepped Voltage Pulse Generator; 10 Voltage Steps; 1 ms Step Duration; Good Voltage Regulation  
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10336  
(PULSE GENERATORS)  
(Marx)  
250-KV PULSE GENERATOR FOR ELECTRICAL-PULSE TECHNOLOGY  
V.I. Kurets  
Tomsk Polytechnic Institute, Tomsk, USSR  
Instruments And Experimental Techniques, Vol. 24, No. 1, pp 123-124 (02/1981)  
Trans. From: Pribury i Tekhnika Eksperimenta 1, (January-February 1982)  
The paper describes the circuit and design of the GIN-250 generator of 250-kV pulsed voltage with adjustable pulse repetition rate of up to 10 Hz and a pulse energy of 780 J. The generator is provided with an acoustically insulated discharger reducing the noise level to 60 dB. 3 Refs.  
Primary Keywords: GIN-250 Marx Generator; 250 kV Output Voltage; Spark Gap Switch; Compact Design; Rep-rated: 10 Hz Repetition Rate  
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10337  
ASSEMBLY AND HANDLING APPARATUS FOR THE EBFA MARX GENERATOR  
G.E. Staller, G.E. Mielt, J.D. Hamilton, M.F. Aker and G.A. Daniels  
Sandia Labs, Albuquerque, NM 87115  
(05/1979)  
Availability: SAND-78-2239  
NTIS  
Marx generators, a major slow-pulsed power component in Sandia Laboratories' Electron Beam Fusion Accelerator (EBFA), were assembled at a remote facility modified to utilize an assembly-line technique. Due to the size and weight of the various components, as well as the final Marx generator assembly, special handling apparatus was designed. Time and manpower constraints required that this assembly be done in parallel with the construction of the Electron Beam Fusion Facility (EBFF). The completed Marx generators were temporarily stored and then moved from the assembly building to the EBFF using special transportation racks designed specifically for this purpose. (ERA citation 04:049411)  
Primary Keywords: Electron Beam Fusion Accelerator; Construction; Design; Mechanical Structures; Power Supplies; Supports  
Secondary Keywords: ERDA/700208; ERDA/700293; Marx Generators; NTISDE

10338  
HIGH CURRENT PULSER FOR EXPERIMENT NO. 225. NEUTRINO ELECTRON ELASTIC SCATTERING  
C. Dalton, G. Krauss and J. Sarjeant  
Los Alamos National Labs, Los Alamos, NM 87545  
No. CONF-790622-13, 5p (6/1977).  
Availability: LA-UR-79-1571  
NTIS  
With the advent of low-cost honeycomb extrusions of polypropylene sheets, flash chambers have become very attractive for large nuclear particle detector arrays. This has brought about the need for a pulse power system that will provide high peak currents and low levels of spurious radiation. Each module of 10 flash chambers will require a peak current of 70 kA with a rise time ( $\tau_{sub r}$ ) of <50 ns, giving a maximum rate of current rise  $dI/dt$  of 400 kA/ $\mu$ s. The pulser output must develop 7 kV across a load of 0.36 ohms with a pulse width of 500 ns. The repetition rate will be one per second. The paper describes the development of such a system and the impact of the physical limitations of present component technology on lifetime and pulse fidelity. (ERA citation 04-049073)  
Primary Keywords: Pulse Generators; Radiation Detectors; Design; Gas Scintillation Detectors; Neutrino Detection; Power Supplies  
Secondary Keywords: ERDA/440101; NTISDE

10339  
(ENERGY STORAGE, KINETIC; PARTICLE BEAMS, ELECTRON)  
(Electron Ring; Generation)  
CONCEPT FOR ENERGY-STORAGE RINGS AT 10-100 MJ  
F.S. Falber and R.O. Hunter Jr.  
Western Research Corp., San Diego, CA 92121  
Journal Of Applied Physics, Vol. 53, No. 6, pp 3961-3966 (06/1982).  
A concept is considered for storing 10-100 MJ of electrical energy in a relatively lightweight and compact device. Energy is stored as electron kinetic energy confined in the vertical betatron field of a toroidal ring. Electrons are injected into a ring at full voltage but low current and low power. The stored electron energy is released on a fast time scale. Synchrotron radiation, wall fields, and instabilities constrain the energy that can be stored in each ring.  
15 Refs.  
Primary Keywords: Energy Storage; Electron Rings; Betatron Concept; Electron Extraction; Design Considerations; Theory  
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10340  
(SWITCHES, CLOSING)  
(Gas Gaps, Optical)  
UV LASER TRIGGERING OF HIGH-VOLTAGE GAS SWITCHES  
J.R. Woodward, C.A. Frost and T.A. Green  
Sandia Labs, Albuquerque, NM 87115  
Journal Of Applied Physics, Vol. 53, No. 7, pp 4734-4739 (07/1982).  
Two different techniques are discussed for uv-laser triggering of high-voltage gas switches using a KrF laser (248 nm) to create an ionized channel through the dielectric gas in a spark gap. One technique used an uv laser to induce breakdown in SF<sub>6</sub> at 6%. For this technique, we present data that demonstrate a jitter of  $\sim$ 150 ps for a 0.5-MV switch at 80% of its self-breakdown voltage using a low-divergence KrF laser. The other scheme uses additives to the normal dielectric gas, such as tripropylamine, which are selected to undergo resonant two-step ionization in the uv laser field. 11 Refs.  
Primary Keywords: Spark Gap; Laser Triggering; KrF Laser; Volume Ionization; 150 ps jitter; SF<sub>6</sub> at 6% Gas; Tripropylamine Gas  
COPYRIGHT: 1982 AMERICAN INSTITUTE OF PHYSICS. REPRINTED WITH PERMISSION

10341  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
HIGH-CURRENT HIGH-PRESSURE DISCHARGE CHAMBER. I  
G.G. Antonov, V.S. Borodin, A.I. Zaitsev and F.G. Rutberg  
Soviet Physics-Technical Physics, Vol. 17, No. 10, pp 1680-1683 (04/1973).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki 42, 2121-2126 (October 1972)  
A high-current high-pressure discharge is investigated. The current, voltage, temperature, and electron density are determined experimentally. A 165 sec constriction is formed in the discharge channel until the diaphragm opens. The results are discussed. 10 Refs.  
Primary Keywords: Gas Discharge; Voltage Measurement; Current Measurement; Temperature Measurement; Electron Density Measurement; Discharge Channel Pinching  
COPYRIGHT: 1973 AMERICAN INSTITUTE OF PHYSICS. REPRINTED WITH PERMISSION

10342  
MICROPROCESSOR-CONTROLLED, PROGRAMMABLE RAMP VOLTAGE GENERATOR  
J. Hopwood  
Sandia Labs, Albuquerque, NM 87115  
(11/1978).  
Availability: SAND-78-8040  
NTIS  
A special-purpose voltage generator has been developed for driving the quadrupole mass filter of a residual gas analyzer. The generator is microprocessor-controlled with desired ramping parameters programmed by setting front-panel digital thumb switches. The start voltage, stop voltage, and time of each excursion are selectable. A maximum of five start-stop levels may be preselected for each program. The ramp voltage is 0 to 10 volts with sweep times from 0.1 to 999.99 seconds. (ERA citation 04-027713)  
Primary Keywords: High-voltage Pulse Generators; Mass Spectrometers; Control Equipment; Microprocessors; Pulse Shapers  
Secondary Keywords: ERDA/440300; Sweep Generators; Automatic Control; NTISDE

10343  
ANALYSIS OF AN INDUCTIVE ENERGY HIGH PERVEANCE ELECTRON BEAM GENERATOR  
M. Weiner  
ECM, Fort Monmouth, NJ 07703  
Research and development technical rept. No. DELET-TR-78-31, 11p (11/1978).  
Availability: AD-A065 114/15T  
NTIS  
No abstract available.  
Primary Keywords: Pulse Generators; Electron Beams; High Energy; High Voltage  
Secondary Keywords: High Perveance; Specific Energy; NTISDODXA

10344  
UNIVERSAL PULSE GENERATOR WITH A NANOSECOND FAST RESPONSE  
S.G. Besiladze  
Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy. (01/1977).  
Availability: JINR-13-10622  
NTIS  
A pulse generator with nanosecond action is described; it is mainly designed for testing and tuning fast electronic devices operating with pulses in the N/1M standard. The generator is principally based on integral circuits and has wide functional possibilities: it includes a main-pulse channel, a delayed-pulse channel, and an overall output which sums up these pulses; in addition to the logic pulse outputs it includes a linear pulse output with an amplitude smoothly regulated in the range from 0.3 to 6.0 V. It can operate in the self-oscillation mode, in the pulse series formation mode, in the starting mode, and in the single-start mode. Two generators are placed in a double-width CAMAC cell. The generation frequency is from 1 Hz to 75 MHz, pulse duration from 8 to 320 ns, and pulse front duration 2 ns. (Atomindex citation 09:392512)  
Primary Keywords: Pulse Generators; Camac System; Delay Circuits; Diagrams; Integrated Circuits; Mhz Range 01-100; Nuclear Instrument Modules; Performance; Pulse Rise Time; Specifications  
Secondary Keywords: IN RUSSIAN; ERDA/440300; USSR; NTISINIS; NTISFNUR  
Distribution Restriction: U.S. SALES ONLY.

10345  
SYSTEM FOR HIGH-VOLTAGE SUPPLY OF MAGNETOSTRICTION SPARK CHAMBERS IN THE 'PHOTON' FACILITY  
Y.S. Anisimov, L.S. Boitova, A.F. Elishav, Y.V. Zenevskii and A.B. Ivanov  
Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy. (01/1977).  
Availability: JINR-13-10570  
NTIS  
A system of high-voltage supply to 32 1x1 m exp 2 magnetostriiction spark chambers of the experimental unit 'Photon' is described. Thyratrons TGII-500/16 are used as commutating elements. The system ensures smooth and independent control of the amplitude of the high voltage pulse at each chamber. Reduction in the amplitude of high-voltage pulses at the spark chambers does not exceed 1%, and the amplitudes of the pulsed sweeping fields are not affected by the presence of limiting stabilizers in the sweeping field multipliers. (Atomindex citation 09:392421)  
Primary Keywords: High-voltage Pulse Generators; Wire Spark Chambers; Control System; Diagrams; Electric Potential; Performance; Pulse Shapers; Thyratrons  
Secondary Keywords: IN RUSSIAN; ERDA/440104; USSR; NTISINIS; NTISFNUR  
Distribution Restriction: U.S. SALES ONLY.

10346  
STUDY ON THE TGII-500/16 THYRATRON CHARACTERISTICS  
Y.S. Anisimov, A.F. Elishav, Y.V. Zenevskii, A.I. Malakhov and B.M. Starchenko  
Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy. (01/1977).  
Availability: JINR-13-10569  
NTIS  
The characteristics of 98 TGII-500/16 carmel thyratrons used in the system of high-voltage supply to the magnetostriiction spark chambers of the 'Photon' unit have been investigated. The operating mode of the thyratrons with a positive current bias has been chosen, which ensures the optimum time parameters. The average values of the delay and the front of the high-voltage pulse are 80 and 45 ns, respectively, at a filament voltage of 6.3 V and an average bias current of 4 mA. (Atomindex citation 09:392422)  
Primary Keywords: High-voltage Pulse Generators; Wire Spark Chambers; Diagrams; Electric Currents; Performance; Pulse Rise Time; Thyratrons  
Secondary Keywords: IN RUSSIAN; ERDA/440104; USSR; NTISINIS; NTISFNUR  
Distribution Restriction: U.S. SALES ONLY.

10347  
ANNUAL PROGRESS REPORT NUMBER 1, 1 JANUARY THROUGH 31 DECEMBER 1978  
Stanford University, Stanford, CA 94305  
No. SU-SEL-78-031, 84p (10/1978).  
Availability: AD-A064 744/65Y  
NTIS  
Contents: Information Systems; Computer Systems; Solid State and Integrated Electronics; Radioscience; and Plasma Physics.  
Primary Keywords: Electronics; Digital Computers; Integrated Circuits; Data Processing; Tropospheric Scatter Communications; Single Crystals; Magnatrons; Pulse Generators; Electron Beams; Signal Processing; Aluminum Gallium Arsenide; Transport Properties  
Secondary Keywords: NTISDODXA

10348  
LOW-RESISTANCE WIDE-BAND LOAD OF KILGAMPERE PULSE GENERATORS  
V.A. Shvets  
Joint Inst. for Nuclear Research, Dubna (USSR). (01/1978).  
Availability: JINR-13-10302  
NTIS  
The results of studies are given of dissipative loads used in high-power pulse generators. It is shown that in the SIF range loads do not meet broad-band requirements. Made for the electron beam monochromator of a linear induction accelerator low-resistance loads from 0.9 to 8 Ohm operate at a pulse rising time of 10 exp -19 s, a current amplitude of up to 2 kA, a pulse duration of 0.5 to 2  $\mu$ s, and a pulse repetition frequency of up to 50 Hz. (Atomindex citation 09:398792)  
Primary Keywords: High-voltage Pulse Generators; Linear Accelerators; Diagrams; Electric Conductivity; Mhz Range 100-1000; Performance Testing; Pulse Rise Time; Rectifiers  
Secondary Keywords: IN RUSSIAN; ERDA/440300; USSR; NTISINIS  
Distribution Restriction: U.S. SALES ONLY.

10349 GTI-742 STROKE PULSE GENERATOR MADE IN THE CAMAC STANDARD

Kim Yu Zou and A.P. Kryachko  
Joint Inst. for Nuclear Research, Dubna (USSR).  
(01/1976).  
Availability: JINR-10-9800  
NTIS

A tectstroke generator (GTI-742) made in CAMAC standard is described. The unit ensures output tact pulses with decade frequency intervals from the internal quartz oscillator and can be used as an external signal frequency divider. The number of decades in the unit is 6. Maximum frequency of the quartz oscillator and external signals is 50 mc. Input and output signals have NIM or TTL levels. (Atomindex citation 09:376718)

Primary Keywords: Pulse Generators; Camac System; Flowsheets; Mhz Range 01-100; Microelectronic Circuits; Performance; Quartz

Secondary Keywords: IN RUSSIAN; ERDA/440300; USSR; NTISINIS  
Distribution Restriction: U.S. SALES ONLY.

10350 PULSE GENERATOR UTILIZING SUPERCONDUCTING APPARATUS

D.B. Birx  
Department of the Navy, Washington, DC  
Patent Application No. PAT-APPL-928 218, 12p (07/1981).  
Availability: AD-D005 725/75T  
NTIS

High power, phase coherent pulses are generated by superconducting apparatus which includes a superconducting cavity resonator that is pumped by a low power microwave source while being isolated from a load. Switching of the cavity to an emitting mode is accomplished in 5 to 10 nanoseconds by firing a gas discharge tube that acts to couple the cavity to the load while decoupling it from the pumping source. (Author)

Primary Keywords: Patent Applications; Pulse Generators; Cavity Resonators; Superconductivity; Gas Discharges; High Power; Microwave Equipment

Secondary Keywords: NTISGPN  
Distribution Restriction: AVAILABILITY: THIS GOVERNMENT-OWNED INVENTION AVAILABLE FOR U.S. LICENSING AND, POSSIBLY, FOR FOREIGN LICENSING. COPY OF APPLICATION AVAILABLE NTIS.

10351 REFLEX TRIODE WITH UNIDIRECTIONAL ION FLOW

A. Bromborsky, H.E. Brandt and R.A. Kehs  
Harry Diamond Labs, Adelphi, MD 20783  
Technical memo. No. HDL-TM-78-22, 13p (10/1978).  
Availability: AD-A063 597/95T  
NTIS

Experimental results show that the ion beam generated by a simple reflex triode can be made almost totally unidirectional toward the virtual cathode. This flow is accomplished by constructing the triode so that a controlled surface flashover generates plasma on only one side of the dielectric anode foil. (Author)

Primary Keywords: Triodes; Ion Beams; Pulse Generators; Plasma Generators; Ionization; Surface Properties; Dielectric Films; Foils (Materials); Field Emission; Cathodes (Electron Tubes); Anodes (Electron Tubes)

Secondary Keywords: Reflex Triodes; NTISDODXA

10352 HIGH VOLTAGE NANOSECOND PULSER USING A REPETITIVE SERIES INTERRUPTER

M. Weiner  
Department of the Army, Washington, DC  
Patent Application No. PAT-APPL-895 421, 11p (04/1987).  
Availability: AD-D005 442/95T  
NTIS

A pulse generation system using an inductive energy storage technique is described. A high magnitude current flowing in a storage inductor is suddenly halted by means of a repetitive series interrupter device and an accompanying magnetic field coupled control circuit. The resulting high voltage generated causes breakdown across a spark gap and transmission of a high energy pulse to a load. The invention described herein may be manufactured and used by or for the Government for governmental purposes without the payment of any royalties thereon or therefor. (Author)

Primary Keywords: Patent Applications; Pulse Generators; High Voltage; High Energy

Secondary Keywords: Short Pulses; Inductive Energy Storage; NTISGPA  
Distribution Restriction: AVAILABILITY: THIS GOVERNMENT-OWNED INVENTION AVAILABLE FOR U.S. LICENSING AND, POSSIBLY, FOR FOREIGN LICENSING. COPY OF APPLICATION AVAILABLE NTIS.

10353 DEVICE FOR AUTOMATION CONTROL OF THE MEHP-2 MODULATOR OF THE 'KRON' ION SOURCE

V.G. Rudnikov  
Joint Inst. for Nuclear Research, Dubna (USSR).  
(01/1977).  
Availability: JINR-9-10395  
NTIS

A device is described for automatic power control at the MEHP-2 modulator outlet. The modulator has a maximum power in the pulse of 40 kw and serves to impart power to the electron beam in the 'Kron' electron-ray source of multi-charged ions. The device ensures a remote lead-out and control of powerful pulse systems. (Atomindex citation 09:379490)

Primary Keywords: Ion Sources; Control Systems; Electronic Circuits; High-voltage Pulse Generators

Secondary Keywords: ERDA/440301; NTISINIS  
Distribution Restriction: U.S. SALES ONLY.

10354 HIGH INTENSITY ELECTRON BEAM PROPAGATION BETWEEN TWO PLANE CONDUCTORS AND ITS IMPLICATIONS FOR COLLECTIVE ION ACCELERATION

H.S. Uhm and H. Kim  
University of Maryland, College Park, MD 20742  
No. PUB-78-243, 28p (01/1978).  
Availability: AD-A059 337/65T  
NTIS

This paper examines the properties of a high intensity relativistic electron beam propagating between two grounded plane conductors, with particular emphasis on the implications for collective ion acceleration. The steady-state and time averaged equilibrium properties are obtained analytically, by employing a one-dimensional model. Numerical integration of pulsed-beam propagation is shown to result in an oscillatory state around the time averaged equilibrium solution. Based on this investigation, a model of linear beam collective ion acceleration is presented. It is shown that within a few nanoseconds of acceleration time, the ion kinetic energy can be increased to more than ten times electron energy. (Author)

Primary Keywords: Ion Accelerators; Linear Accelerators; Ion Beams; Electron Beams; Pulse Generators; Electron Energy; Plasmas (Physics); Current Density; Constants; Dielectric Properties; Space Charge; Computerized Simulation

Secondary Keywords: NTISDODXA

10355 ROTATING BALL GENERATOR

E. Kunhardt and R. Dollinger  
Texas Tech Univ Lubbock Dept of Electrical Engineering  
Interim rept. (12/1976).  
Availability: AD-A059 265/95T  
NTIS

No abstract available.  
Primary Keywords: Pulse Generators; Electromechanical Devices; Pulse Rate; Charge Transfer; Reprints

Secondary Keywords: Steel Balls; Rotating Ball Generators; NTISDODXR  
Distribution Restriction: AVAILABILITY: PUB. IN THE REVIEW OF SCIENTIFIC INSTRUMENTS, V48 N12 P1676-1677 DEC 77.

10356 STUDY ON THE MAKING OF COCKROFT WALTON HIGH TENSION

S. Hutapea  
Gamma Research Centre, Yogyakarta, Indonesia  
(01/1976).  
Availability: PB08-1117-76  
NTIS

A prototype of a generator is being developed at the GAMA Research Center. Experience in working with some components, high voltage capacitor, column, and potential divider is discussed. High voltage diode, the type which is usually used in television, is used. The tension of the generator is measured by using the high ohmic resistance of 4000 megohm. The maximum tension can be reached no more than 150000 volts. (Atomindex citation 09:365746)

Primary Keywords: Cockcroft-Walton Accelerators; Capacitors; Electric Potential; Fluctuations; Pulse Generators

Secondary Keywords: ERDA/430300; Indonesia; NTISINIS  
Distribution Restriction: U.S. SALES ONLY.

10357 SHF IMPULSE GENERATOR

J.R. Andrews and E.E. Baldwin  
National Bureau of Standards, Boulder, CO 80302  
Final rept. May-Sep 77 No. NBSIR-78-888, 76p (06/1978).  
Availability: PB-285 233/35T  
NTIS

A super-high-frequency (SHF) impulse generator designed and built by the National Bureau of Standards, is described in detail. The generator produces three different waveforms. The first is a simple impulse of 1 volt amplitude (3 V option) and 60 ps duration with a useful spectrum (15 dB down) extending from low frequencies out to 9 GHz. The second waveform is a single cycle 5 GHz sine wave (doublet) of 0.8 volts peak-to-peak amplitude (1.6 V option). Its useful spectrum extends from 0.5 GHz to 11.7 GHz. The third waveform is an exponentially damped rf pulse. It has a center frequency of 12.5 GHz and a damping time constant of 1/4 ns. The peak-to-peak amplitude is 0.6 volts. The useful spectrum extends from 6 GHz to 18 GHz.

Primary Keywords: Pulse Generators; Waveform Generators; Superhigh Frequencies

Secondary Keywords: Picoseconds; Time Domain; NTISCOMNBS; NTISDODAF

10358 (ENERGY CONVERSION. ELECTRICAL)  
(CHARGING CIRCUITS)

A SLOW CYCLING FLUX PUMP USING DIGITAL CONTROL  
T.F. Droege (1), J.R. Purcell (2) and S.T. Wang (2)  
(1) Fermi National Accelerator Lab, Batavia, IL 60510  
(2) Argonne National Lab, Argonne, IL

IEEE Transactions On Magnetics, Vol MAG-11, No. 2, pp 580-581 (03/1975).  
A slow cycling flux pump has been constructed where operation is controlled by digital logic driving a high power operational amplifier. Hall sensors allow closed loop control of the secondary currents to enable switching the heater driven power cryotrons at the optimum time. Operating efficiency of 87% has been achieved. 2 Refs.

Primary Keywords: Flux Pump; High Power Op-amp Control; 87% Operating Efficiency; Superconductivity; Cryotrons; Air Core Transformer

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10359 NONLINEAR QUASI-AXIAL LINE FOR SHOCK ELECTROMAGNETIC WAVE PRODUCTION

R.V. Khar'yuzov and V.A. Shvats  
Joint Inst. for Nuclear Research, Dubna (USSR).  
(01/1975).  
Availability: JINR-13-8709  
NTIS

Results are given as to the manufacture of sharpeners with a low wave-making resistance for forming shock electromagnetic waves. Kilampere current amplitudes are obtained with input voltage being some kilovolts. Duration of the shock wave front is 1 nsec. The sharpeners have been designed for the system of electron beam monochromatization in LILU - 30 linear induction accelerator of IBR - 2 exploratory complex. (Atomindex citation 09:352420)

Primary Keywords: Beam Dynamics; Linear Accelerators; Capacitors; Diagrams; Electric Currents; Ferrites; High-voltage Pulse Generators

Secondary Keywords: ERDA/430200; USSR; NTISINIS  
Distribution Restriction: AVAILABILITY IN MICROFICHE ONLY. U.S. SALES ONLY.

10360

## LIGHTWEIGHT LINE PULSER

M.J. Blinichikoff  
Westinghouse Defense and Electronic Systems Center Baltimore Md Systems Development Div  
Final technical report, 1 May 76-1 Dec 77 No. 78-0099, 55p (04/1978).  
Availability: AD-A054 266/05T  
NTIS

This report describes the work performed under contract F30602-76-C-0207 to study, develop, and demonstrate the feasibility of a compact, lightweight, modular, pulse-forming network (PFN). The PFN evolved is composed of identical IC modules and an input module that is optimized for a pulse-plateau ripple that satisfies the goal of  $\pm 0.5$  percent. The ripple remains within this limit as modules are added or removed from the PFN to change the pulsewidth in 2 microsec steps. This low-ripple response is achieved without incorporating mutual inductance into the design; therefore, easing the module tuning and assembly. Mutual inductance has been considered indispensable in PFN's, but it is a roadblock for modular construction. Its elimination as a design parameter is the key to realizing the modular PFN. All electrical design goals are satisfied and the size goal was achieved by a wide margin. The realized volume energy density of 0.1 joules/cu in. was the best achievable with off-the-shelf capacitors. The goal of 0.5 joules/cu in. is not compatible with present state-of-the-art components at these power levels. Included herein are results of the following studies undertaken to satisfy the original contract objectives. Theoretical analysis of distributed and lumped constant lines that can realize the PFN.

Primary Keywords: Pulse Generators; Modules(Electronics); Lightweight; Modulators; Radar Equipment  
Secondary Keywords: Lightweight Line Pulsers; Pulse Forming Networks; NTISD00XA

10361

## INVERSE DIODE STUDY (FINAL REPORT)

Authors Unknown  
Physic International Co. San Leandro, CA 94577  
(09/1977).  
Availability: PFR-959  
NTIS

The experimental work and resultant data of an inverse diode study program sponsored by US ERDA are reported. The thrust of the effort is demonstration of an inverse diode concept, at greater than 100 kA pulsed current and 10 exp 9 W/cm exp 2 energy density levels, for conversion of relativistic electron beam energy into useful electromagnetic energy. The experiments show that the entire injected electron current can be utilized by the inverse diode and more than 70 percent of the injected beam energy can be extracted to supply a secondary diode of matched impedance. An implication of these findings is that design of a vacuum current function, in which multiple beams can be combined to produce beyond state-of-the-art power and current levels in a secondary load, is feasible. A theoretical calculation of electron scattering through thin foils is appended. (ERA citation 03:025404)

Primary Keywords: Electron Sources; Pulse Generators; Aluminum; Design; Electromagnetic Pulses; Electrons; Feasibility Studies; Foils; Performance Testing; Power Range 100-1000 Mw; Research Programs; Scattering; Stainless Steels; Titanium; US ERDA  
Secondary Keywords: ERDA/700103; NTISDE

10362

## AVALANCHE TRANSISTOR PULSER FOR FAST-GATED OPERATION OF MICRO-CHANNEL PLATE IMAGE-INTENSIFIERS

A. Lundy, J.R. Parker, J.S. Lunsford and A.D. Martin  
Los Alamos National Labs, Los Alamos, NM 87545  
No. CONF-771023-6, 8p (01/1977).  
Availability: LA-UR-77-2402  
NTIS

Transistors operated in the avalanche mode are employed to generate a 1000 volt 10 to 30 nsec wide pulse with less than 4 nsec rise and fall times. This pulse is resistively attenuated to approximately equal to 270 volts and drives the image intensifier tube which is a load of approximately equal to 200 pF. To reduce stray inductance and capacitance, transistor chips were assembled on a thick-film hybrid substrate. Circuit parameters, operating conditions, and coupling to the microchannel plate image-intensifier (MCP exp 2) tube are described. To provide dc operating voltages and control of transient voltages on the MCP exp 2 tube a resistance-capacitance network has been developed which (a) places the MCP exp 2 output phosphor at ground, (b) provides programmable gains in "f-stop" steps, and (c) minimizes voltage transients on the MCP exp 2 tube. (ERA citation 03:024987)

Primary Keywords: Image Intensifiers; Pulse Generators; Chemical Explosives; Design; Detonations; Logic Circuits; Phosphors; Photocathodes; Resolution; Sensitivity; Switches; Transistors  
Secondary Keywords: ERDA/440300; ERDA/450100; Drives(Electronics); NTISCE

10363

## AN INVESTIGATION OF THE HOLLOW SPHERICAL CATHODE: PART I. EMISSION MECHANISMS OF HOLLOW SPHERICAL CATHODES: PART II. DEVELOPMENT OF A HIGH LEVEL PULSER

K. R. BRUNN  
University of Illinois, Urbana IL  
No. SR-10 386p (04/1977).  
Availability: AD-117 036/45T  
NTIS

No abstract available.  
Primary Keywords: Cathodes; Pulse Generators; Analysis; Design  
Secondary Keywords: NTISD00X  
Distribution Restriction: DISTRIBUTION LIMITATION NOW REMOVED. NOTE: ONLY 35MM MICROFILM IS AVAILABLE. NO MICROFICHE.

10364

## INVESTIGATION OF THE RESISTIVE PHASE IN HIGH POWER GAS SWITCHING (RESEARCH AND DEVELOPMENT REPORT)

R.C. O'Rourke  
Science Applications, La Jolla, CA 92037  
No. SA-1-77-518-11-86p (01/1977).  
Availability: JCR-13776  
NTIS

A theoretical study was made of the resistive phase in high pressure gas switching with the regime of interest being (10 to 500 kV from 100 to 1000 Hz) to (1000 to 10000 Hz, 100 to 1000 pF). The resistive phase was examined as a function of applied field, gas species, inductance, gas type and pressure, and electron water of the initiating and quenching phases as regards system performance (e.g., the jitter problem) were examined. The cooling and electrode debris removal effects of the vortex gas flow on the operating characteristics of the system were considered. (ERA citation 03:015695)

Primary Keywords: High-voltage Pulse Generators; Design; Gases; Heat Transfer; High Pressure; Laboratory Equipment; Power Supplies; Pulse Circuits; Simulation; Spark Gaps; Electronic Circuits  
Secondary Keywords: ERDA/420800; NTISDE

10365

## PRELIMINARY DESIGN OF A 300 KEV ELECTRON GUN FOR A HIGH POWER CO-SUB 2/ LASER AMPLIFIER

J. Katzenstein, P.K. Mosavi, Y. Kahanzadeh and M. Teharzadeh  
Atomic Energy Organization of Iran, Tehran, Nuclear Research Center.  
No. NRC-76-31, 26p (07/1976).  
Availability: AEOI-65  
NTIS

The object of this report is to describe the design of a 300 KeV electron gun which could be constructed at the Nuclear Research Centre of the Atomic Energy Organization of Iran. Included are the specifications, circuit diagram and many necessary calculations. The design itself was chosen because of its simplicity, so no attempt was made toward an advanced or sophisticated model. However, the basic design, as presented in the report, should satisfy the present requirements of the program. (Atomindex citation 03:131523)

Primary Keywords: Carbon Dioxide Lasers; Electric Charges; Electron Guns; Kev Range 100-1000; Pulse Generators  
Secondary Keywords: ERDA/420300; Iran; NTISINIS  
Distribution Restriction: AVAILABLE IN MICROFICHE ONLY. U.S. SALES ONLY

10366

## DESIGN AND DEVELOPMENT OF A HIGH-POWER, 500 KV PULSED LINE

A. Nicolas  
CEA Centre d'Etudes de Valduc, Is-sur-Tille, France  
(09/1977).  
Availability: SAND-77-6018  
NTIS

A study was made of very high voltage (500 kV) pulse production for 50 ns at half height. A coaxial line was coupled to a Marx generator for obtaining the pulses on an impedance-adapted electron diode. The maximum power obtained was  $6.4 \times 10 \exp 10$  W with a current front in the diode of about 30 ns (80 ns pulse length at half height). (ERA citation 03:012963)

Primary Keywords: High-voltage Pulse Generators; Anodes; Cathodes; Coaxial Cables; Design; Electric Generators; Functional Models; Mathematical Models; Power Supplies; Testing  
Secondary Keywords: ERDA/420800; Transistors; France; NTISDET  
Distribution Restriction: TRANSLATION BY P. NEWMAN OF CEA-R-4733.

10367

## PULSED POWER SUPPLY FOR INJECTION BUMP MAGNETS

M.F. Freag  
Argonne National Lab, Argonne, IL  
(01/1977).  
Availability: CONF-770607-4  
NTIS

A very precise and relatively inexpensive charging circuit for an energy storage capacitor bank feeds an efficient thyristor-controlled pulse-forming discharge circuit. These circuits, which generate magnet pulses of 300 joules at a rate of 30 per second, are analyzed. (ERA citation 03:007278)

Primary Keywords: Zps; Beam Bending Magnets; Beam Injection; Capacitors; Electric Discharges; Power Supplies; Pulse Circuits; Stored Energy; Thyristors  
Secondary Keywords: ERDA/430302; NTISDE

10368

## LONG-DURATION PULSER TO SIMULATE CW OPERATION

G.G. Emert  
Harry Diamond Labs, Washington, DC 20438  
No. TM64 13, 20p (11/1964).  
Availability: AD-453 847/65T  
NTIS

An electronic switch or pulser has been designed to evaluate crossed-field tubes, such as the HDL-developed Rotatron. Feasibility of the pulser design has been proved in simulating CW operation of the Rotatron. The design concept is based on intermittently operating the tube so that the beam of the injection gun is turned on and off repeatedly by applying a voltage to the control anode. The Rotatron investigation was made at 60 pps with a duty factor of 10%. Also described is a modified pulser with improved pulse shape. This pulser has performed relatively well as a modulator for plate pulsing a microwave triode oscillator at X-band at 1000 pps and a duty factor of 50%. (Author)

Primary Keywords: Radiofrequency Pulses; Circuits; Electronic Switches; Radiofrequency Pulses; Crossed Field Devices; Electron Beams; Electric Guns; Modulators; X Bands; Microwave Oscillators; Pulse Amplifiers; Triodes; Voltage  
Secondary Keywords: NTISD00X  
Distribution Restriction: DISTRIBUTION LIMITATION NOW REMOVED. NOTE: ONLY 35MM MICROFILM IS AVAILABLE. NO MICROFICHE.

10369

RESEARCH ON THE PHYSICS OF PULSED MHD GENERATORS  
M.S.J. Jones, V.M. Blackman, R.C. Brumfield, E.W. Evans and C.N. McKinnon  
Mhd Research Inc., Newport Beach, CA  
Final rept., 1 July-30 Sep 63 No. 646, 163p (12/1963).  
Availability: AD-626 448/75T  
NTIS

Two systems are discussed for producing short pulses of electrical power by MHD principles. The first system is driven by condensed explosives and produces pulses lasting from 1 micro sec to 100 micro sec. The peak power generated to date is 23 kw, with an energy output of 750 joules. The conversion efficiency, chemical to electrical, is 12. Higher conversion efficiencies can be readily achieved. The second system uses the combustion of aluminum with cesium nitrate as the energy source for a supersonic MHD channel. The measured conductivity of the combustion products was 1000 ohm/cm. The highest measured peak power output was 29 watts. The experimental data indicate a large electrode drop which must be overcome before currents can flow in the generator. A favorable scaling potential is indicated. (Author)

Primary Keywords: Magnetohydrodynamics; Pulse Generators; Energy Conversion; Electric Power Production; Shock Waves; Rare Gases; Argon; Explosives; Recording Systems; Combustion; Blast; Electrodes; Magnetic Fields; Probes (Electromagnetic); Pressure; Magnets  
Secondary Keywords: MHD Generators; NTISD00DX  
Distribution Restriction: DISTRIBUTION LIMITATION NOW REMOVED. NOTE: ONLY 35MM MICROFILM IS AVAILABLE. NO MICROFICHE.

10370

RESEARCH ON THE PHYSICS OF CONTINUOUS AND PULSED MHD GENERATORS  
M.S.J. Jones, V. Blackman, C. McKinnon, E. Evans and T. Neff  
Mhd Research Inc., Newport Beach, CA  
Semiannual technical rept. no. 2, 1 Jan-30 Jun 63 (08/1963).  
Availability: AD-616 299/65T  
NTIS

No abstract available.  
Primary Keywords: Electric Power Production; Magnetohydrodynamics; Pulse Generators; Explosions; Deflagration; Propellants; Explosives; Shock Waves; Energy Conversion; Explosion Gases  
Secondary Keywords: Pulsed MHD Generators; NTISD00DX  
Distribution Restriction: DISTRIBUTION LIMITATION NOW REMOVED. NOTE: ONLY 35MM MICROFILM IS AVAILABLE. NO MICROFICHE.

10371

PENETRATION OF PULSED ELECTROMAGNETIC WAVES INTO CONDUCTING MEDIA  
L.M. Vailles  
ITT, Nutley, NJ  
No. 62-2, 20p (12/1961).  
Availability: AD-326 888/55T  
NTIS

The distributions of steady state and of transient electromagnetic plane waves at the surface of separation between air and ground (or sea) was computed. These distributions are important for such applications as undersea and geodetic explorations from points located outside the conducting media; the methods of measurement may be simplified by use of a transmission line analogy, which permits the use of comparison or of substitution methods. In addition, it was shown that if a rectangular pulse d.c. magnetic plane wave is transmitted from a point within the conducting medium and received at another point of the same, the system may be used for purposes of ranging or for purposes of communication between transmitting and receiving stations. (Author)

Primary Keywords: Communication Systems; Electromagnetic Radiation; Electromagnetism; Geophysics; Sea Water; Underwater; Air; Alternating Current; Analysis; Antennas; Antisubmarine Warfare; Detection; Dielectrics; Dipole Antennas; Direct Current; Electric Discharges  
Secondary Keywords: NTISD00DX  
Distribution Restriction: DISTRIBUTION LIMITATION NOW REMOVED. NOTE: ONLY 35MM MICROFILM IS AVAILABLE. NO MICROFICHE.

10372

(BREAKDOWN STUDIES)  
(Exploding Wires)  
ALUMINUM FLUORIDE EXPLODING-WIRE LASER  
W.M. Rice and R.J. Jensen  
Los Alamos National Labs., Los Alamos, NM 87545  
Applied Physics Letters, Vol. 22, No. 2, pp 67-68 (01/1973).

Intense aluminum fluoride laser pulses in the spectral range 12.5-13.5u were observed when fine aluminum wires were exploded into fluorine gas. The laser excitation occurred during the expansion phase of the wire explosion. 10 Refs.  
Primary Keywords: Aluminum Wires Exploded In Fluorine Gas; AIF Laser Pulses (12.5-13.5u); P/sub 2/ Pressures 12.7-42.4 Torr  
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10373

HYBRID EM METHODS  
I. Katz, D.E. Parks, A. Wilson, J.M. Harvey and M. Rotenberg  
Systems Science and Software, La Jolla, CA 92038  
Final rept. No. 555-R-76-2976, 78p (05/1977).  
Availability: AD-A039 771/15T  
NTIS

This report summarizes a study of hybrid electrostatic-electromagnetic techniques for the calculation of SCEMP generated surface currents. Presented are results using the hybrid SQUID code, a technique to treat the currents in small struts, and a theory of nonreflective boundary conditions for electromagnetic SCEMP codes. (Author)  
Primary Keywords: Electromagnetic Pulses; Hybrid Circuits; Pulse Generators; Electrostatic Generators; Electromagnetic Radiation; Electric Current; Struts; Photoelectrons; Artificial Satellites; Motion; Reflection  
Secondary Keywords: System Generated Electromagnetic Pulses; Surface Currents; Hybrid Squid Codes; NTISD00DX

10374

THE APPLICATION OF STEEP PULSE CURRENTS TO THE ELECTROHYDRAULIC AND MAGNETIC FORMING OF METALS  
J. Gzylowski, T. Les, R. Malowski and I. Bednarski  
American Meteorological Society, Boston, MA  
No. 1-P-3, 20p (04/1966).  
Availability: AD-685 505/25T  
NTIS

The results of a project carried out by the authors in electrohydraulic and magnetic metal forming are given. The circuits employed, the pulse current generator, and the properties of such circuit components as capacitors, trigger and working gaps, and working coils, are described in detail. The conditions for the generation of shock waves in connection with exploding wire phenomena are given, and the current curves are presented together with calculations of the power and energy dissipated. In addition, some examples of aluminum and transformer sheet forming are given. Finally, the design of tubular shunts for the measurement of steep current pulses, their properties, and testing methods are discussed. (Author)

Primary Keywords: Material Forming; Metals; Explosive Forming; Shock Waves; Electric Currents; Circuits; Hydraulic Equipment; Electromagnetic Fields; Pulse Generators; Electric Discharges; Underwater; Exploding Wires; Aluminum  
Secondary Keywords: Translations; NTISD00DX  
Distribution Restriction: DISTRIBUTION LIMITATION NOW REMOVED.

10375

PULSE COMPRESSION TUBES  
A.W. Hadley and E.R.J. Wingrove  
General Electric Co., Syracuse, NY 13201  
Quarterly progress rept. no. 5, 1 Jul-30 Sep 65 No. 983-GH-155-5, 12p (01/1967).  
Availability: AD-607 411/45T  
NTIS

Effort was devoted to finalizing stripline circuits, evaluating vendor items, and adjusting the system to meet the limited funds available. Utilizing the presently available funds will permit the assembly of 16 of the 128 taps originally planned. These 16 taps will be constructed in blocks of 8, as originally planned, to prove the effectiveness of the delay line time-sharing technique. If the performance of the 16-tap unit is satisfactory, the remainder of the system can be readily added when additional funding is available. Design during this quarter was devoted to finalizing a reliable, reproducible coding network and stripline delay trimmer. A preliminary study was made of pneumatic equalizers, but it is felt that they will not be necessary in the delay chain. All major components required in the 16-tap system have been ordered, including the chain amplifiers. (Author)

Primary Keywords: Pulse Compression; Matched Filters; Broadband; Pulse Generators; Coding; Strip Transmission Lines; Delay Lines; Amplifiers; Circuits  
Secondary Keywords: NTISD00DX  
Distribution Restriction: DISTRIBUTION LIMITATION NOW REMOVED.

10376

HIGH POWER MODULATOR (SCR)  
W.R. Olson, R.A. Smith, S.J. Gourse, T.P. Nowalk and A.M. Knopp  
Westinghouse Electric Corp., Baltimore MD Surface Div  
Interim technical rept. no. 1, Apr-1 Oct 66 (03/1967).  
Availability: AD-813 081/75T  
NTIS

This report includes the efforts expended on device refinement circuit design and development of a building for high power modulators utilizing the Type 291 flat packaged thyristor in a series stack configuration. An experimental breadboard modulator having a minimum holdoff of 10KV and switching a minimum of 375 amperes has been designed and the preliminary stages of construction are described. The preliminary design of a 65KV modulator using these building blocks as major components is described. (Author)  
Primary Keywords: Silicon Controlled Rectifiers; Modulators; Integrated Circuits; Modules (Electronics); Power; Manufacturing; Thermal Properties; Pulse Generators

Secondary Keywords: Thyristors; NTISD00DX  
Distribution Restriction: DISTRIBUTION LIMITATION NOW REMOVED.

10377

HIGH POWER PULSE COMPRESSION TECHNIQUES  
A.G. Stewart  
Department of the Army, Washington, DC  
Patent No. PAT-APPL-631 793, 5p (01/1977).  
Availability: AD-D003 946/15T  
NTIS

A method and apparatus are described for compressing high intensity current pulses and for providing an impedance transformation which increases the magnitude of the current of the pulses. A pulse is injected into a transmission line and after the pulse energy is converted to entirely electrostatic form the transmission line is discharged along the length thereof instead of out the end. The transmission line may be longitudinal, or in the shape of a torus, and the discharging may be either synchronous or asynchronous. The method and apparatus may be useful in compressing deuterium/tritium pellets to the point of nuclear burn. (Author)

Primary Keywords: Patents; Pulse Compression; Pulse Generators; High Power; Nuclear Fusion; Deuterium; Tritium; Electric Current; Electric Arcs  
Secondary Keywords: PAT-CL-333-20; NTISGPA  
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10378

A NEW LASER POWER SUPPLY  
C. Cason  
Army Missile Command, Redstone Arsenal, AL 35894  
No. RR-TR-64-14, 32p (07/1964).  
Availability: AD-683 724/15T  
NTIS

The feasibility of a variety of power supply systems which may be used to deliver the required electrical power to a laser flash tube is considered. Recommendations for a special pile-type battery are made, upon its performance superiority for a minimum advance in technology, as compared to the effectiveness of other systems in an assumed advanced state of development. A specific system is recommended to satisfy the requirements of a proposed flash tube. Output power density of the recommended battery is about 250,000 kw per cubic meter while the recoverable stored electrochemical energy is expected to be more than 75 million joules per cubic meter. (Author)

Primary Keywords: Lasers; Energy Conversion; Power Supplies; Pulse Generators; Magnetohydrodynamic Generators; Flash Lamps; Feasibility Studies; Storage Batteries  
Secondary Keywords: Flash Tubes; NTISD00DX  
Distribution Restriction: DISTRIBUTION LIMITATION NOW REMOVED.

10379  
AN OUTPUT EXPRESSION FOR A DISPERSIVE DELAY PULSE COMPRESSION FILTER  
UNDER ARBITRARY INPUTS  
M.R. Jones  
Naval Postgraduate School, Monterey, CA 93940  
Master's thesis (05/1966).  
Availability: AD-843 555/95T  
NTIS

Pulse compression filters are used extensively in modern radar systems. The nature of output waveforms from dispersive delay pulse compression filters driven by specific matched input waveforms has been studied in great detail for these radar applications. However, little work has been done to generalize these results. This paper obtains an expression for the filter output in terms of arbitrary input signals. Several particular input waveforms are analyzed using an ideal filter with assumed specific characteristics. In an attempt to indicate trends, different pulse widths and linear frequency modulation rates are assumed for the pulse shapes chosen. The resulting output envelopes are plotted graphically. (Author)

Primary Keywords: Pulse Compression; Matched Filters; Waveform Generators; Radar Signals; Delay Lines; Integral Transforms; Frequency Modulation; Statistical Processes; Special Functions (Mathematical); Electromagnetic Pulses

Secondary Keywords: Chirp Filters; Dispersive Delay Lines; NTISDDDX  
Distribution Restriction: DISTRIBUTION LIMITATION NOW REMOVED

10380  
ABSORPTION OF LIGHT IN GASES  
E.L.I. Sloan and E.L. Kerr  
Perkin-Elmer Corp., Norwalk, CT  
Final rept. 1 Nov 64-31 Jul 67 No. PE-ER-8884, 61p (07/1967).  
Availability: AD-818 134/95T  
NTIS

Two methods of measuring optical molecular absorptivities in gases, potentially capable of approaching theoretical sensitivity limits of 10 to the minus 8th power/cm were studied. An acoustic method was pushed experimentally to a sensitivity of 10 to the minus 5th power/cm absorptivity. Practical obstacles to further improvement have been found for the acoustic method. The second method, a laser illuminated spectrophotometer, was also investigated. Its performance was much closer to the theoretical limit.

Primary Keywords: Gases; Light Transmission; Light Absorption; Carbon Oxide; Water Vapor; Atmospheres; Absorption Spectra; Molecular Spectroscopy; Lasers; Pulse Generators; Acoustic Detectors; Heating; Membranes; Resonators; Gas Lasers; Nitrogen; Prisms (Optics)

Secondary Keywords: Confocal Resonators; Optical Ring; Ruby Lasers; Spectrophotometers; NTISDDDX  
Distribution Restriction: DISTRIBUTION LIMITATION NOW REMOVED

10381  
GENERATION OF SHORT DURATION PULSES IN LINEAR MHD GENERATORS  
M.S.J. Jones, C.M. McKinnon and V.H. Blackburn  
Mhd Research Inc., Newport Beach, CA  
(01/1964)  
Availability: AD-821 935/94T  
NTIS

It is demonstrated that short pulses of electrical power can be generated by MHD principles using condensed explosives as the energy source. This work has been particularly successful in that large pulses of power have been obtained with relatively high conversion efficiencies. The scaling of these results to larger sizes to produce systems with greater outputs appears relatively straightforward. Additional work is needed to determine the optimum values for the various parameters; however, the basic principles are well understood and the direction for future work to increase output and efficiency can be clearly outlined.

Primary Keywords: Magnetohydrodynamics; Pulse Generators; Explosive Gases; Magnetohydrodynamics; Shaped Charges; Rdx; Cesium; Ions; Detonations; Velocity; Pressure; Electrical Conductivity

Secondary Keywords: NTISDDDX  
Distribution Restriction: DISTRIBUTION LIMITATION NOW REMOVED

10382  
GENERATION OF FRACTION OF A TERAGAUSS PROTON PULSES WITH COAXIAL REFLEX  
TRICOTS  
J. Golden, C.A. Kapetanakis, S.J. P. and S.J. Stephanakis  
Naval Research Lab., Washington, DC 20375  
Interim rept. No. NRL-MR-3422, 21p (12/1976).  
Availability: AD-A035 873/15T  
NTIS

Results are reported on the generation of MeV, pulsed ion beams at a peak power level in excess of  $2 \times 10^{10}$  to the 11th power watts that have an angular divergence of about 3 degrees - 4 degrees. Such beams can be used in the formation of field reversing proton rings.

Primary Keywords: Proton Beams; Production; Ion Beams; Pulse Generators; Triodes; Nuclear Reactions

Secondary Keywords: NTISDDDX, NTISDDNRL

10383  
10-KV PULSE GENERATOR: PULSE TEST ON AUTODIN FILTER DEMONSTRATES GENERATOR CAPABILITY  
J. Elliott, H.M. Kojihara and M.N. Smith  
Naval Civil Engineering Lab., Port Hueneme, CA  
Final technical rept. 1 Jul 67-30 Jun 68 No. NCEL-YR-596, 39p (09/1968).  
Availability: AD-841 152/25T  
NTIS

This report describes a newly developed pulse voltage generator which provides up to 10 kv of 2, 10, and 100-microsecond pulse voltage. These pulses can be superimposed at any phase angle on the base 60-Hertz power provided to operate the test item. Tests with this generator make feasible a more accurate determination of the pulse response behavior of test items under operational conditions because pulse testing is performed with the test item fully energized. To illustrate the type of information obtainable, test data on a radio frequency interference suppressing AUTODIN power line filter is presented. It was found (1) that this type of filter develops high-frequency oscillatory voltages at the output when the input 60-Hertz power contains a pulse voltage; (2) these oscillatory voltages could be suppressed by placing capacitance across the filter input and output; and (3) filters can be designed to be free of high-frequency oscillatory voltages. (Author)

Primary Keywords: Pulse Generators; Transmission Lines; Low Pass Filters; Transients; Radiofrequency Interference; Electronic Equipment; Failure; Electromagnetic Pulses; Thyristors; Communication Systems; Voltage; Diagrams

Secondary Keywords: Autod (Automatic Digital Network); Automatic Digital Networks; Gaussian Filters; Power Lines; NTISDDDX  
Distribution Restriction: DISTRIBUTION LIMITATION NOW REMOVED

10384  
THE CAPABILITIES OF ELECTRON BEAM-SEMICONDUCTOR ACTIVE DEVICES  
C.B.J. Norris  
Stanford University, Stanford, CA 94305  
No. TR-672701, 25p (10/1968)  
Availability: AD-844 915/95T  
NTIS

Some properties of a class of active elements employing an electron beam to control the output current of a semiconductor device are discussed in this paper. It is shown that the basic beam-semiconductor devices have high gains, fast response and large output capability. Numerical data are given that allow the capabilities of the device to be evaluated in a given application. It is shown that the extreme configurational flexibility of the device may be employed to enhance its basic performance capability as well as to realize unique devices that can rapidly perform complex functions. (Author)

Primary Keywords: Semiconductor Devices; Ionization; Electron Beams; Electron Irradiation; Microwave Amplifiers; Electronic Switches; Gain; Optimization; Response; Pulse Generators; Control Systems

Secondary Keywords: NTISDDDX  
Distribution Restriction: DISTRIBUTION LIMITATION NOW REMOVED

10385  
SPARK GAP NANOSECOND PULSE GENERATOR  
B.R. Gray  
Department of the Air Force, Washington, DC  
Patent No. PAT-APPL-61 888, (02/1972).  
Availability: PATENT-3 644 747  
NTIS

An apparatus for generating a short duration higher peak voltage pulse from a basic lower pulse voltage of longer duration. A series of spark gaps are arranged such that the total voltage from the basic long duration pulse is applied to each gap in succession. A delay line with a fixed delay which is equal to the total breakdown time of all the other gaps is connected across each spark gap.

Primary Keywords: Patents; Spark; Gap; Nanosecond; Pulse; Generator

Secondary Keywords: PAT-CL-307-106; NTISGFAF  
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10386  
RESETTABLE MONOSTABLE PULSE GENERATOR  
M.M. Garrahan  
National Aeronautics and Space Administration, Washington, DC  
Patent No. PAT-APPL-756 511, 25p (02/1972).  
Availability: PATENT-3 569 744  
NTIS

This disclosure describes a resettable monostable pulse generator including a charge rundown-timing circuit. The charge rundown-timing circuit includes a capacitor that is charged to a peak value by a random pulse from a constant amplitude pulse source. After being charged, the capacitor immediately starts to discharge toward zero. In addition, an output pulse generator starts to generate an output pulse as soon as the capacitor is charged to its peak value and continues to generate the output pulse until the charge drops to a predetermined level. If a second pulse from the constant amplitude pulse source occurs during this rundown period, the capacitor is again charged to its peak value. This reset pulse prevents termination of the output pulse and recycles the termination time of the output pulse (pulse width) to be measured from the inception of the last reset pulse. Each time a reset pulse occurs during a rundown period, the capacitor is recharged to its peak value; hence, the output pulse can exist for a short or long period of time depending on the occurrence of random reset pulses.

Primary Keywords: Patents; Resettable; Monostable; Pulse; Generator

Secondary Keywords: PAT-CL-307-273; NTISGFAF  
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10387  
(BREAKDOWN STUDIES)  
(Plasma)  
DENSE PLASMA DISCHARGES FOR SOLID-TARGET HEATING  
I.M. Vitkovitsky, L.S. Levine, D. Mosher and S.J. Stephanakis  
Naval Research Laboratory, Washington, DC  
Applied Physics Letters, Vol. 23, No. 1, pp 9-11 (06/1973).  
19 Refs.

Primary Keywords: Exploding Wire Discharges; High Current Density; Electron Beams; Beam-plasma Interaction; Target Damage And Current Density

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10388  
CONCEPTUAL DESIGN OF AN AUTO-RESONANT ACCELERATOR EXPERIMENT  
W.E. Drummond, G.I. Bourianoff, E.P. Cornet, D.E. Hasti and W.H. Rienstra  
Austin Research Associates Inc., TX  
Final rept. No. ARA-224, 307p (11/1976).  
Availability: AD-A033 946/55T  
NTIS

Conceptual design and specifications for a proof-of-principal Auto-Resonant Accelerator have been undertaken. In particular, the pulse power source and diode configuration, the diode to waveguide transition and compression sections, magnetic field characteristics, phase locking and wavegrowth requirements, and the method of ion loading and acceleration have been examined. Specifications and conceptual designs for these five areas are presented along with several considerations of overall system requirements. (Author)

Primary Keywords: Ion Accelerators; Cyclotron Resonance; Phase Locked Systems; Electron Beams; High Energy; Stability; Pulse Generators; Radio Fields; Diodes; Magnetic Fields

Secondary Keywords: NTISDDDX

10389

## WIDE PULSE LOW PRF PULSE GENERATOR

R.A. Benning and R.W. McNeil  
Department of the Air Force, Washington, DC  
Patent No. PAT-APPL-808 824, (10/1971).  
Availability: PATENT-3 611 204

NTIS

A pulse generator capable of producing wide low PRF pulses having fast rise and fall times is realized by circuits which alternately drive a bistable device. A multivibrator is periodically placed in a first stable state by a unijunction transistor relaxation oscillator having a slow period of oscillation. The multivibrator is returned to its second stable state by a unijunction transistor circuit that is activated by the first stable state voltage condition of the multivibrator. A time delay circuit associated with the unijunction transistor circuit delays actuation of the unijunction transistor and thus establishes the pulse width of the pulse generator.

Primary Keywords: Patents; Wide; Pulse; Low; PRF; Pulse; Generator  
Secondary Keywords: PAT-CL-331-111; NTISGPAF  
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10390

## PULSE CIRCUIT FOR RADIAC SETS

R.E. Jähle and D.P. Helm  
Department of the Navy, Washington, DC  
Patent No. PAT-APPL-816 182, (04/1971).  
Availability: PATENT-3 576 440

NTIS

In a G.M. radiac set which has a multivibrator meter circuit having an ammeter between the bistable switchable elements, a pulse generator for providing a periodic feed through pulse to the G.M. tube. The feed through pulse is added to a tube pulse only when they occur simultaneously, to provide a high amplitude counting pulse for the meter circuit.

Primary Keywords: Patents; Pulse; Circuit; Radiac  
Secondary Keywords: PAT-CL-250-188; NTISGPN  
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10391

## PULSE GENERATOR

T.W. Pearce, A.K. Hochberg and T.D. Poehler Jr.  
Department of the Navy, Washington, DC  
Patent No. PAT-APPL-645 358, (06/1970).  
Availability: PATENT-3 518 455

NTIS

A pulse generator for the provision of high-energy short-duration pulses. A capacitor is charged by a DC power source and is made to discharge through a load when a first external pulse triggers a first SCR circuit. When it is desired that the high-energy pulse be turned off, a second and delayed external pulse is caused to trigger a second SCR circuit. When said second SCR circuit is triggered, the energy stored in the capacitor is directed toward a dissipative network and is thereby diverted from the load. The duration of the high-energy pulse can be closely controlled since said duration depends basically upon the delay between the initiation of the first and second external triggering pulses.

Primary Keywords: Patents; Pulse; Generator  
Secondary Keywords: PAT-CL-373-265; NTISGPN  
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10392

## ELECTRICAL PULSE GENERATORS

R. Buser, G.K. Gaul and R.L. Ross  
Department of the Army, Washington, DC  
Patent No. PAT-APPL-672 658, (03/1970).  
Availability: PATENT-3 500 078

NTIS

A generator of pulses of high energy level and current wherein a strong magnetic field emanating from a superconducting magnet is interrupted by explosively driving a coil or other electrically conductive member past said magnetic field. One or more load coils in which the high energy pulses are to appear may be driven across the superconductor magnetic field, or a flux displacer can be driven so as to alter suddenly the magnetic field flux from the superconducting magnet passing through a stationary load coil or coils.

Primary Keywords: Patents; Electrical; Pulse; Generators  
Secondary Keywords: PAT-CL-310-13; NTISGPA  
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10393

## EXPLOSIVE PULSE GENERATOR

R.L. Conger and J.W. Johnson  
Department of the Navy, Washington, DC  
Patent No. PAT-APPL-710 968, (12/1969).  
Availability: PATENT-3 484 627

NTIS

An explosive magnetic flux compressor for producing high current pulses with optimum flux build up and maximum current delivered to the output load. A variable load resistance which initially shorts out the output load, operates to switch current generated in the compressor to the output load as resistance is increased in the variable load resistance from heating due to high current generated in the compressor.

Primary Keywords: Patents; Explosive; Pulse; Generator  
Secondary Keywords: PAT-CL-310-10; NTISGPN  
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10394

## OSCILLON PULSE GENERATOR OF THE GROUNDED GRID TYPE EMPLOYING A DELAY LINE STORAGE MEANS

R.W. Johnson, T.E. Klippert and W.J. Kemler  
Energy Research and Development Administration  
Patent No. PAT-APPL-645 582, (07/1969).  
Availability: PATENT-3 457 517

NTIS

A high current pulsed electron source including a grounded grid electron gun. A coaxial delay line charged from a voltage source is connected to the cathode of the electron gun via a coaxial mercury-wetted switch to provide a nanosecond duration driving pulse therefor. The components of the system are matched in characteristic impedance.

Primary Keywords: Patents; Electron; Pulse; Generator; Grounded; Grid; Employing; Delay; Line; Storage  
Secondary Keywords: PAT-CL-328-231; NTISGPAEC  
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10395

## HIGH VOLTAGE FIELD-REVERSAL PULSE GENERATOR USING A LASER SWITCHING MEANS TO ACTIVATE A FIELD EMISSION X-RAY TUBE

J.B. Robison  
Energy Research and Development Administration  
Patent No. PAT-APPL-410 328, (03/1969).  
Availability: PATENT-3 432 664

NTIS

A fast high voltage, high current pulse generator wherein high voltage on a first insulated elongated conductor is switched between second and third similar concentric conductors is switched to an end of the second conductor, providing an electric field reversal and generation of a high voltage, high current pulse at the ends of said second and third conductors.

Primary Keywords: Patents; High; Voltage; Field-Reversal; Pulse; Generator; Laser; Switching; Activated; Field; Emission; X-Ray; Tube  
Secondary Keywords: PAT-CL-307-455; NTISGPAEC  
Distribution Restriction: THIS GOVERNMENT-OWNED INVENTION AVAILABLE FOR U.S. LICENSING AND, POSSIBLY, FOR FOREIGN LICENSING. COPY OF PATENT AVAILABLE COMMISSIONER OF PATENTS, WASHINGTON, D.C. 20231 60.50.

10396

## TRIGGER PULSE CIRCUIT

W.E. Egan  
Department of the Navy, Washington, DC  
Patent No. PAT-APPL-662 259, (04/1968).  
Availability: PATENT-3 381 146

NTIS

The patent specification and drawings describe a system for controlling the current to an inductive load by utilizing a silicon controlled rectifier capacitor discharge circuit operating from an A.C. source and having a trigger pulse source and a transient suppressor diode.

Primary Keywords: Patents; Trigger; Pulse; Circuit  
Secondary Keywords: PAT-CL-307-305; NTISGPN  
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10397

## FAST PULSE GENERATOR UTILIZING AN ELECTRON BEAM TO CAUSE AN ARC BREAKDOWN ACROSS THE GAP REGION OF A COAXIAL LINE CENTER CONDUCTOR

G.A. Kerna  
Energy Research and Development Administration  
Patent No. PAT-APPL-658 484, (12/1967).  
Availability: PATENT-3 360 678

NTIS

In a fast pulse generator, the combination comprising a coaxial transmission line having an outer and an inner conductor, a first portion of said inner conductor being spaced from the outer conductor and from the remainder of the inner conductor of said line, means producing an electrostatic field between said first portion of said inner conductor and said outer conductor of said coaxial line, and a pulsed electron beam generator directing energized electrons between said first portion of said inner conductor and an adjacent one of said conductors to effect discharge of said electrostatic field.

Primary Keywords: Patents; Fast; Pulse; Generator; Electron; Beam; Cause; Arc; Breakdown; Across; Gap; Region; Coaxial; Line; Center; Conductor  
Secondary Keywords: PAT-CL-315-3; NTISGPAEC  
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10398

## PULSE GENERATOR WITH STANDING WAVE ENERGY STORAGE

W.R. Baker  
Energy Research and Development Administration  
Patent No. PAT-APPL-402 042, (07/1967).  
Availability: PATENT-3 333 203

NTIS

This invention is an electronic circuit for producing a high power output signal comprising a predetermined number of signal cycles over a precisely defined pulse time period. In the circuit, standing waves are generated in a high Q pulse line from a low power signal generator. The energy stored in the standing waves is discharged by suddenly connecting the line to a matching load.

Primary Keywords: Patents; Pulse; Generator; Standing; Wave; Energy; Storage  
Secondary Keywords: PAT-CL-328-59; NTISGPAEC  
Distribution Restriction: THIS GOVERNMENT-OWNED INVENTION AVAILABLE FOR U.S. LICENSING AND, POSSIBLY, FOR FOREIGN LICENSING. COPY OF PATENT AVAILABLE COMMISSIONER OF PATENTS, WASHINGTON, D.C. 20231 60.50.



10399

## REOTELY CONTROLLED POWER PULSE GENERATOR

L.L. Morse

Department of the Navy, Washington, DC

Patent No. PAT-APPL-347 094, (08/1966).

Availability: PATENT-3 267 415

NTIS

This invention relates to a system for generating short high-powered pulses in a low impedance circuit, such as in a sonar transmitter, and to means for supplying the power and triggering information to the generator through a high impedance circuit.

Primary Keywords: Patents; Remotely; Controlled; Power; Pulse;

Secondary Keywords: PAT-CL-340-3; NTISGPN

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10400

## ELECTRICAL PULSE GENERATOR

A.M. Stott

Department of the Army, Washington, DC

Patent No. PAT-APPL-341 470, (07/1966).

Availability: PATENT-3 259 769

NTIS

The invention relates to electro-mechanical energy converters or generators of the type adapted for converting high-magnitude input impulses of mechanical energy into peak output pulses of electrical energy.

Primary Keywords: Patents; Electrical; Pulse; Generator

Secondary Keywords: PAT-CL-310-14; NTISGPA

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10401

## MODIFIED MARX GENERATOR

A.E. Schofield

Energy Research and Development Administration

Patent No. PAT-APPL-304 701, (01/1966).

Availability: PATENT-3 229 124

NTIS

This invention relates to voltage multipliers of the Marx type and, more particularly, a modified Marx circuit which minimizes power dissipation and embodies safety features not heretofore found in Marx generators.

Primary Keywords: Patents; Marx; Generator

Secondary Keywords: PAT-CL-307-110; NTISGPAEC

Distribution Restriction: THIS GOVERNMENT-OWNED INVENTION AVAILABLE FOR U.S. LICENSING AND, POSSIBLY, FOR FOREIGN LICENSING. COPY OF PATENT AVAILABLE COMMISSIONER OF PATENTS, WASHINGTON, D.C. 20231 \$0.50.

10402

## MARX DEVELOPMENT PROJECT

Authors Unknown

Maxwell Labs Inc, San Diego, CA 92123

Final rept. No. MLR-49, 378p (04/1970).

Availability: AD-668 671/95T

NTIS

The program requirement was for a compact, fast, highly reliable Marx generator of an advanced integrated design utilizing components such as switches and capacitors that have been optimized for these applications. A plastic-cased 45 kV, 700 joule energy storage capacitor was developed which exceeds the program goal of 99.97% probability of survival for 5,000 shots in typical Marx generator service. A matching switch with 40 kA peak current capability at 0.6 Cb charge transfer for 40,000 shots life expectancy was also developed; both of these key components were extensively tested and proved. A non-folded Marx circuit, using completely graded construction and employing the novel concept of triggering each stage via a small (fast Marx generator was designed). This circuit was realized, using the specialized Marx capacitor and switch hardware, as a 5.6 MV, 185 kJ fast Marx generator for practical demonstration of the design. This 6.8 microhenry generator is now undergoing a full-energy test program without difficulty. The basic design is extendable with minimal effort to a wide range of energy and voltage. (Author)

Primary Keywords: Pulse Generators; Design; Capacitors; Electric Switches; Sparks

Secondary Keywords: Aurora Project; Marx Generators; NTISDODXD

Distribution Restriction: DISTRIBUTION LIMITATION NOW REMOVED.

10403

## SOLID-STATE TWO MODULATOR

M.M. Mott and D.B. Keveragh

Naval Electronics Lab, San Diego, CA

Research and development report, Apr 66-Apr 69 No. NELC-1659, 34p

(12/1969).

Availability: AD-867 916/95T

NTIS

An S-band linear FM (chirp) signal generator, utilizing a backward wave oscillator (BWO) and a solid-state two modulator-driver circuit, was developed as part of an experimental high-range-resolution radar. The modulator-driver BWO was found to have a 3.5 to 2.9 GHz linear sweep with a 600-MHz bandwidth, a 0.300 microsecond pulsewidth, and a pulse compression ratio or time-bandwidth product of 180. In addition, it has the capability of operating to a maximum prf of 25 kHz without distortion of the chirp signal, and its maximum deviation from linear FM is less than 0.07 percent. (Author)

Primary Keywords: Radar Equipment; Modulators; Modulators; Backward Wave Amplifiers; Signal Generators; Radar Equipment; Pulse Compression; Frequency Modulation; S Band; Resolution

Secondary Keywords: NTISDODXD

Distribution Restriction: DISTRIBUTION LIMITATION NOW REMOVED.

10404

## CHEMICAL REACTION HERTZIAN GENERATOR

K.S. Kunz

BDM Corp, Albuquerque, NM 87106

Final rept. 31 May-31 Dec 73 No. BDM/A-1-74-TR, 139p (05/1974).

Availability: AD-920 469/45T

NTIS

This effort represents a first attempt at combining the two separate technologies of explosive flux compression and Hertzian generation for the purpose of obtaining ultra-high energy pulses at microwave frequencies. A number of interesting concepts were analyzed and three were selected by the contractor as most deserving of future attention. It is hoped that this report will stimulate further imaginative and creative thought in this direction leading eventually to a successful technique for accomplishing the aforementioned goal. (Author)

Primary Keywords: Pulse Generators; Microwave Equipment; Magnetic Fields; Compression; Energy Conversion; Pulses; Power Supplies; High Explosives; Ferroelectric Materials; Energy Storage; Microwave Oscillators; Reaction Kinetics; Frequency Shift; Mirrors; Doppler Effect

Secondary Keywords: Flux Compression; Frozen E Field Devices; Frozen B Field Devices; Brillouin Scattering; Hertzian Generators; Chemical Generators; NTISDODXD

Distribution Restriction: DISTRIBUTION LIMITATION NOW REMOVED.

10405

## DUAL MODE GUN DEVELOPMENT (PHASE I)

A. Saharian

Teledyne Mac Palo Alto Calif

Final rept. 17 Sep 71-28 Feb 73 (08/1973).

Availability: AD-915 220/85T

NTIS

The major limitation on dual mode tube performance in a THT is caused by the large gain change that accompanies power change when beam current is varied. A technique is described to reduce this by altering the beam size and current distribution as the total current magnitude is varied. Small signal gain calculations are described for a variety of solid and hollow beam sizes, voltages and currents. The effect of varying cathode voltage is calculated and results are presented for both high and low permeance beams. Based on the theoretical calculations two electron guns were designed and built. Current density distribution from these guns was measured in an electron beam analyzer and focusing of the beam produced by one of the guns was measured in a beam taster. (Author)

Primary Keywords: Traveling Wave Tubes; Pulse Amplifiers; Electron Gun; Dual Mode; Electron Beams; Variations; Magnetic Fields; Direct Current; Voltage; Focusing; Gain; Nonlinear Systems; Solenoids; Efficiency; Continuous Waves; Coupling Circuits; Antenna Feeds

Secondary Keywords: Pervence; Hollow Beams; NTISDODXD

Distribution Restriction: DISTRIBUTION LIMITATION NOW REMOVED.

10406

## HIGH CURRENT PULSER CIRCUIT

W.S. Watson

Department of the Navy, Washington, DC

Patent No. PAT-APPL-588 998, 4p (05/1974).

Availability: AD-D02 716/95T

NTIS

The circuit shapes and amplifies a logic pulse to drive loads which require high current levels such as light emitting diodes or semiconductor lasers. Automatic load protection and high speeds are provided by an inductor shunt within the circuit. The simplicity and lack of capacitors in the circuit make it ideal for gun fired applications such as optical telemetry.

Primary Keywords: Pulse Generators; Patents; Circuits; Drivers (Electronics); Logic Circuits; Current Limiters; Stability

Secondary Keywords: PAT-CL-307-270; NTISGPN

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10407

## NOTE ON THE USE OF CHARGE INJECTION FOR SGEMP SIMULATION

C.L. Longmire

Mission Research Corp, Santa Barbara, CA

Topical rept. 1-31 Dec 74 No. MRC-N-175, 18p (07/1975).

Availability: AD-A027 218/75T

NTIS

This note discusses techniques and rationale for using self-contained electrical pulsers for simulating system-generated electromagnetic pulse (SGEMP) generated by x rays striking satellites. (Author)

Primary Keywords: Electromagnetic Pulse Simulators; Pulse Generators; Self Contained; Simulation; Radiation Damage; Nuclear Explosions; X Rays; Artificial Satellites

Secondary Keywords: Charge Injection; SGEMP (System Generated Electromagnetic Pulses); System Generated Electromagnetic Pulses; NTISDODXA

10408

## 100-KA DIRECT DRIVE EMP PULSER

J.E. Allen

GTE Sylvania, Inc, Needham Heights, MA 02194

Availability: PEM-39

NTIS

A pulser is described which was built to directly drive 100 kA into a Minuteman silo closure seal. The pulser has a 50-kV charge voltage, a 10-nanosecond rise time and a 50 microsecond fall time. Physical features and performance characteristics are described along with a summary of its successful operation in pulsing the silo cover.

Primary Keywords: Electromagnetic Pulses; Simulation; Pulse Generators; Design; Missile Silos; Physical Radiation Effects; Capacitors; Nuclear Explosions; Power Supplies; Seal

Secondary Keywords: Minuteman; NTISERDA

10409

## SPLIT PULSE GENERATOR

D.J. Hoft and P.R. Shutt  
Department of the Air Force, Washington, DC  
Patent No. PAT-APPL-648 327, 4p (08/1975).  
Availability: AD-D001 916/45T

NTIS

The patent describes a split pulse generator which generates a first half-pulse frequency,  $f$  sub 1, which is different from the second half-pulse frequency,  $f$  sub 2. The output pulse is continuous throughout the pulse width. Thus during transition time in the center of the pulse, the phase is essentially continuous in progressing from  $f$  sub 1 to  $f$  sub 2.

Primary Keywords: Pulse Generators; Patents; Splitting; Radiofrequency Generators; Radar Equipment

Secondary Keywords: PAT-CL-328-28; AN/TPM-19; NTISGPAF  
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20231 \$0.50.

10410

## SPLIT-RING MARK GENERATOR GRADING

D.M. Strickland  
Department of the Air Force, Washington, DC  
Patent No. PAT-APPL-495 672, 5p (09/1975).  
Availability: AD-D001 536/25T

NTIS

The patent concerns metallic tubing bent to a shape consistent with the cross-sectional shape of a Marx generator. Tubing is split into two symmetrical halves and insulated, the halves combined have an initial DC potential equal to one stage voltage, after erection of the Marx the potential collapses to zero.

Primary Keywords: Pulse Generators; Patents; Rings; Control; Transients

Secondary Keywords: Marx Generators; PAT-CL-307-110; NTISGPAF  
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10411

## ELECTROMAGNETIC ASPECTS OF EMP TESTING

E. Marx  
Harry Diamond Labs, Adelphi, MD 20783  
Technical memo. No. HDL-TM-75-14, 24p (10/1975).  
Availability: AD-A018 450/75T

NTIS

General considerations related to testing of complicated systems exposed to EMP by means of a simulator are presented, with special emphasis on the similarities and differences between the pulse generated by a high-altitude burst and the one generated by a simulator. Other aspects of a testing program are also discussed.

Primary Keywords: Electromagnetic; Pulse Simulators; Pulse Generators; Test Methods; Electromagnetic Pulses; Airburst; Energy Transfer; High Altitude; Nuclear Explosions; Electronic Equipment; Vulnerability

Secondary Keywords: NTISD0A; NTISD0A

10412

## PICOSECOND PULSE RESEARCH AT NBS

J.R. Andrews and R.A. Lauton  
National Bureau of Standards, Washington, DC  
Final rept. (01/1975)  
Availability: COM-75-50657/65T

NTIS

A general review of pulse measurement research at the National Bureau of Standards is described which includes work with electrical pulse generators using mechanical switches, avalanche transistors, snap off diodes, tunnel diodes, and laser pulses. Pulse transmission studies which include skin effect, nonuniform dielectric, lossy liquid dielectric and superconductivity are also mentioned together with pulse measurement techniques which include oscillographic techniques and pulse autocorrelation. The interfacing of picosecond pulse measurement instruments with a minicomputer is also described. This has resulted in an Automatic Pulse Measurement System (APMS) which has already been used to measure transmission coefficient 5 sub 21 of some microwave networks.

Primary Keywords: Electromagnetic Pulses; Electrical Measurement; Oscillators; Pulse Generators; Pulse Transmitters

Secondary Keywords: Reprints; Pulses; Picoseconds; NTISCOMB5  
Distribution Restriction: PUB. IN PROCEEDINGS OF JOINT MEASUREMENT CONFERENCE, GAITHERSBURG, MD., 12-14 NOV 74  
P123-140 1975.

10413

A MODEL FOR THE CURRENT PULSES OF CLOUD-TO-GROUND LIGHTNING DISCHARGES  
J.H. G. Lynch and J.B. Thomas  
Princeton University, Princeton, NJ  
(11/1974).  
Availability: AD-A015 501/05T

NTIS

A model for the current pulses of cloud-to-ground lightning discharges is proposed. Characteristics of lightning pulses such as finite rise time, decay time and time of occurrence are incorporated in the model. The mean current and power spectral density are calculated using a numerical technique (Author).

Primary Keywords: Lightning; Pulse Generators; Electric Discharges; Ground/Electrical; Clouds; Power Spectra;

Mathematical Models; Direct Current; Numerical Methods and Procedures; Reprints

Secondary Keywords: Rise Time; Decay Time; Pulse Response; NTISD0DXR; NTISD0DA; NTISNFG

Distribution Restriction: AVAILABILITY: PUB. IN JNL. OF THE FRANKLIN INSTITUTE, V299 N3 P199-210 MAR 75.

10414

## MATCHING A PARTICULAR PULSER TO A PARALLEL-PLATE SIMULATOR

R.W. Lethar, M.I. Sancer and A.D. Vervetis  
AFML, Kirtland AFB, NM 87117  
Final rept. 10 Jul-18 Oct 74 (07/1975)  
Availability: AD-A015 852/95T

NTIS

As electromagnetic energy source that incorporates the peaking capacitor arms of a Marx generator as part of its electromagnetic configuration is to be used in an Electromagnetic Pulse simulator to be built under the supervision of the Air Force Weapons Laboratory. In this report, the positions of the peaking capacitors that fulfill certain desirable null-flux conditions are determined. The characteristic impedance and several other useful properties of the conical base of the pulser are also calculated.

Primary Keywords: Electromagnetic Pulse Simulators; Pulse Generators; Capacitors; Matching

Secondary Keywords: Marx Generators; NTISD0DAF

10415

## TEMPS (TRANSPORTABLE EMP SIMULATOR) FINAL REPORT: VOLUME II. APPENDICES

H. Aslin and R. Ryan  
Harry Diamond Labs, Washington, DC 20438  
Rept. for 1 Sep 71-15 Oct 72 No. PJFR-372-D-Vol-2, 220p (08/1973).  
Availability: AD-A015 621/85T

NTIS

Contents: A Laboratory study of horizontal dipoles--TEMPS; Capacitor development and testing; Prototype marx generator switch evaluation; Switch acceptance testing; Solid resistor development; Solid-dielectric gas-graded peaking capacitor; Single-module peaking capacitor tests.

Primary Keywords: Simulators; Electromagnetic Pulses; Pulse

Generators; Transportable; Capacitors; Resistors

Secondary Keywords: Transportable Electromagnetic Pulse Simulators; NTISD0DA

10416

## TEMPS (TRANSPORTABLE EMP SIMULATOR) FINAL REPORT: VOLUME I

H. Aslin and R. Ryan  
Harry Diamond Labs, Washington, DC 20438  
Rept. for 1 Sep 71-15 Oct 72 No. PJFR-372-D-Vol-1, 23p (08/1973).  
Availability: AD-A015 620/05T

NTIS

This report presents a description of the development, design, fabrication, and field testing of the TEMPS (Transportable EMP Simulator). The basic system is a simulator with the geometry of a cylinder parallel to the ground surface driven at its center by a high voltage capacitive pulser and terminated resistively at its ends to ground. The pulser and cylindrical antenna are supported by means of a dielectric support structure at elevations of up to 20 meters measured from the antenna/pulser centerline to ground. Essentially, TEMPS has three individual subsystems: the pulse generator, the cylindrical antenna, and the support structure.

Primary Keywords: Simulators; Electromagnetic Pulses; Pulse

Generators; Transportable; Antennas

Secondary Keywords: Transportable Electromagnetic Pulse Simulators; NTISD0DA

10417

## PULSE GENERATOR EMPLOYING PLURAL PULSE-FORMING-NETWORKS WITH PULSE PRODUCING MEANS FOR CANCELLATION OF UNDESIRABLE REFLECTED PULSE

M.J. Coyle  
Department of the Army, Washington, DC  
Patent No. PAT-APPL-283 124, 3p (05/1965).  
Availability: AD-D000 830/05T

NTIS

The patent provides a pulse generating circuit which avoids undesirable re-excitation by providing a thyatron tube in one of the pulse forming networks so that the network is terminated in a short circuit at the time the impulse arrives thereto. Due to the action of the thyatron the polarity of the impulse is reversed in the shorted pulse forming network. Thus, the impulses in the two pulse forming networks will be of opposite polarity and will cancel one another when they are reflected back to the load circuit. Hence there can be no re-excitation of the load. It is the principal object of this invention to provide a pulse generating circuit wherein impulses transmitted thereto can be eliminated rather than reflected.

Primary Keywords: Pulse Generators; Patents; Pulses; Reflection;

Cancellation

Secondary Keywords: PAT-CL-328-65; NTISGPA

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20231 \$0.50.

10418

## PULSE GENERATOR EMPLOYING PLURAL PULSE FORMING NETWORKS PROVIDING OVERLAPPED PULSES TO EFFECT RIPPLE CANCELLATION

G.F. Grotz and M.J. Coyle  
Department of the Army, Washington, DC  
Patent No. PAT-APPL-265 600, 3p (06/1965).  
Availability: AD-D000 841/75T

NTIS

The patent relates to pulse forming circuits and more particularly it relates to a pulse forming circuit for supplying very high voltage pulses to microwave transmitter tubes such as klystrons, traveling wave tubes or magnetrons.

Primary Keywords: Pulse Generators; Patents; Microwave Equipment;

Ripples; Cancellation; Transmitters; Microwave Tubes

Secondary Keywords: PAT-CL-328-162; NTISGPA

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10419

## CRACK DETECTION APPARATUS AND METHOD

J.G. Sessler and V. Weiss  
Department of the Navy, Washington, DC  
Patent No. PAT-APPL-345 164, 5 (02/1975).  
Availability: AD-D000 730/25T

NTIS

The patent describes an apparatus and method for non-destructively detecting the presence and the location of crack in materials, using low frequency mechanical vibrations. The material specimen or structure having a crack to be detected is subjected to tensile or compressive forces due to excitation caused by low frequency sound waves or mechanical vibrations from a generator, thus changing the opening and thereby changing the effective size of the crack in the specimen. An ultrasonic search unit is used to follow modulations of reflected energy at the crack interface due to variations of the effective size of the crack. The search unit is controlled by an ultrasonic pulser-receiver which displays the amplitude of echo from the crack on an oscilloscope.

Primary Keywords: Ultrasonic Tests; Ultrasonic Inspection;

Nondestructive Testing; Patents; Cracks; Detection.

Pulse Generators

Secondary Keywords: PAT-CL-73-675-B-R; NTISGPA

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20231 \$0.50.

10420

DEVICE FOR CHARGING ACCUMULATOR OF A POWERFUL PULSED GENERATOR  
A.G. Nikolaev, V.A. Knysh, P.E. Konchankov and V.A. Naumushin  
Army Foreign Sci. and Tech. Center, Charlottesville, VA  
No. FSTC-HT-23-128-74, 6p (06/1974).  
Availability: AD-A008 247/95T

A device for charging the accumulator of a powerful pulse generator, with increased reliability of operation and protection from overloads and overvoltages, is described and illustrated by a diagram. The circuit is kept in resonance with the power supply source; breakdown of the stabilization in the overvoltage protection unit short circuits the power supply and decreases the voltage in the circuits of the device. This prevents overloads and overvoltages on the accumulator.

Primary Keywords: Pulse Generators; Accumulators; Electric Charge;  
Patents; Translations; USSR  
Secondary Keywords: NTISDDDA

10421

ELECTRON BEAM DIODE POWER ACCUMULATOR  
M. Braun and K. Gersumel  
ECOM, Fort Monmouth, NJ 07703

Final rept. 30 May 72-30 Oct 74 (12/1974).  
Availability: AD/A-003 510/05T

A pulse 'power accumulator' amplifier consisting of an output section as power combiner, input tuners and plug-in tubes was designed and fabricated. The output section of the accumulator was designed to operate over a frequency range of 500-1000 MHz and combined r.f. power from four individual plug-in tubes operating in a parallel push-pull mode. Plug-in FET tubes capable of operation in the frequency range of 500-1000 MHz were fabricated. The diodes in these tubes were capable of 200V or more, reverse back bias voltage.

Primary Keywords: Electron Tubes; Pulse Amplifiers; Electron Tube Targets; Semiconductor Devices; Electron Beams; Diodes; Silicon  
Secondary Keywords: Electron Beam Semiconductor Devices; NTISDDDA

10422

ELECTROMECHANICAL PULSER INVESTIGATION  
J.P. Craig, M.O. Magler and K.I. Selin  
RADC, Griffiss AFB, NY 13440

Final rept. 1 Mar 73-28 Feb 74 No. A-002-RADC-1-74, 158p (09/1974).  
Availability: AD-787 674/15T

The report concerns a feasibility study of electromechanical pulsers for the production of short duration, high power pulses with a low duty cycle. The pulse repetition rate is 0-200 pps. The output pulses are 40 kV, 1kA into a 40 ohm resistive load, with pulse duration between 20 and 50 us and with rise and fall times of 3 us or less. Several different approaches have been considered in an attempt to meet the requirements, including variable capacitance, variable reluctance, piezoelectric and electromagnetic generators with and without cryogenic fields. It was found that it is feasible to use an electromechanical pulser with some recommended switching schemes to meet the required pulse shape. Without switching, rise times approximately 13 us and fall times approximately 10 us are feasible. For some applications, a major advantage of an electromechanical pulser over conventional pulse methods is that high repetition rate bursts for short periods of time can be obtained. (Modified author abstract)

Primary Keywords: Pulse Generators; Electromechanical Devices; Feasibility Studies  
Secondary Keywords: NTISDDDAF

10423

DELAYED PULSE GENERATOR  
G.J. Holub  
Department of the Navy, Washington, DC

Patent No. PAT-APPL-236 646, 4 (05/1973).  
Availability: AD-104 968/05T

The patent describes a delayed pulse signal of a predetermined pulse width obtained by having a free running clocking pulse generator provide a series of pulses to a first shift register. The first shift register provides a time delay for a predetermined number of pulses before supplying the delayed pulse signal and an enabling signal to a second shift register. The second shift register provides a time delay for a predetermined number of pulses and then supplies an output signal that inhibits the clock and at the same time inhibits the delayed pulse by resetting the first shift register.

Primary Keywords: Pulse Generators; Patents; Delay; Shift Registers  
Secondary Keywords: PAT-CL-328-55; NTISGPN  
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COMMISSIONER OF PATENTS, WASHINGTON, D.C. 20231 00-50.

10424

A HIGH INTENSITY PULSED SOURCE OF POLARIZED ELECTRONS

M.J. Alguard (1), K.P. Schueler (1), R.D. Ehrlich (2), G. Baum (2) and V.W. Hughes (3)

(1) Yale Univ., New Haven, CT  
(2) Office Of Naval Research, Alexandria, VA  
(3) Chicago Operations Office(AEC), IL

(01/1974).  
Availability: AD-787 001/75T

A polarized electron source using the principle of photoionization of a polarized beam of LiB atoms has been developed. Originally suggested by Fues and Hellmann in 1934 this method led to one of the earliest successful developments of a low-energy prototype source of polarized electrons. The present source, currently being installed at the Stanford Linear Accelerator Center (SLAC), is based upon the prototype design.

Primary Keywords: Electron Beams; Polarization; Photoionization; Pulse Generators; Lithium; Atomic Beams  
Secondary Keywords: Lithium; NTISDDDA  
Distribution Restriction: AVAILABILITY: PUB. IN INTERNATIONAL CONFERENCE ON ATOMIC PHYSICS (4TH), ABSTRACTS OF CONTRIBUTED PAPERS, HEIDELBERG (WEST GERMANY), 27-26 JUL 74.

10425

PICOSECOND PULSE GENERATORS USING MICROMINIATURE MERCURY SWITCHES

J.R. Andrews

National Bureau of Standards, Boulder, CO 80302  
Final rept. FR 1973 No. NBSIR-74-377, 45p (03/1974).  
Availability: COM-74-11449/7

Pulse generators have been built using microminiature mercury switches. A commercial RF coaxial switch was also evaluated as a pulse generator. A superconducting delay line (t sub r = 18 ps, t sub d = 70 ns) and a sampling oscilloscope (t sub r = 22 ps) were used to measure the generated pulse 10%-90% transition time. The best result obtained was a transition time of 39 ps. Pulse amplitudes were independently adjustable up to 50 volts. The microminiature mercury switches in general were found to give very unreliable operation.

Primary Keywords: Pulse Generators; Waveform Generators; Electric Switches; Mercury; Microminiaturization  
Secondary Keywords: Mercury Switches; Picoseconds; NTISCOMB5

10426

HIGH INTENSITY, PULSED THERMAL NEUTRON SOURCE

J.M. Cornner

Atomic Energy Commission, Washington, DC  
Patent No. PAT-APPL-351 893, 5p (12/1973).  
Availability: PATENT-3 778 627

The invention relates generally to neutron sources and more particularly to pulsed thermal neutron sources. Specifically, this invention is concerned with a novel apparatus for slowing down fast neutrons in such a manner as to create highly intense pulses of thermal neutrons.

Primary Keywords: Neutron Sources; Patents; Pulse Generators; Thermal Neutrons; Moderators  
Secondary Keywords: PAT-CL-250-499; NTISGPAEC  
Distribution Restriction: GOVERNMENT-OWNED INVENTION AVAILABLE FOR LICENSING; COPY OF PATENT AVAILABLE  
AVAILABLE COMMISSIONER OF PATENTS, WASHINGTON, D.C. 20231 00-50

10427

CHEMICAL TO ELECTROMAGNETIC ENERGY CONVERSION TECHNIQUES

R.W. Wenzel

Advanced Kinetics Inc., Costa Mesa, CA  
Final rept. May 72 Mar 74 (06/1974).  
Availability: AD-783 901/2

The objective of the work was to develop techniques for conversion of the very high density energy stored chemically to pulses of electrical energy. Reliable low cost single shot converters have been demonstrated by investigators in explosive flux compression technology. The techniques investigated are for use in high power lightweight transmitter experiments in support of TP05. Multiple shot magnetic flux compression concepts were analyzed, experimentally verified, and categorized as to potential device use. The concepts investigated have the capability for multiple pulse operation and all involved the rapid deceleration of either explosively driven shock fronts or explosively driven metallic projectiles in a magnetic field. The effects of physical parameters of the decelerated medium and the magnetic field were experimentally verified and parameter tradeoffs were developed.

Primary Keywords: Energy Conversion; Pulse Generators; Magnetic Fields; Exothermic Reactions; Detonation Waves; Pistons; Compression; Explosives; Flux(Rate); Interactions; Projectiles; Magnets; Electromagnetic Pulses; Accelerations; Deceleration; Multiple Operation  
Secondary Keywords: NTISDDDAF

10428

ANALYSIS OF DISCRETE PULSE FORMING NETWORKS DRIVING NON-LINEAR FLASH LAMP LOADS

O.C. Barr

Naval Research Lab, Washington, DC 20375  
Final rept. No. NRL-RR-2808, 76p (06/1974).  
Availability: AD-782 399/0

An interactive design tool for analyzing discrete lumped parameter pulse forming networks driving time invariant nonlinear flashlamp loads is described. The program is written in FORTRAN IV for the Control Data Kronos timesharing system. The program handles linear (resistive) loads as well as xenon flashlamps. The formulation is structured to allow easy modification. Up to 10 mesh PFN's can be handled. (Author)

Primary Keywords: Pulse Generators; Flash Lamps; Xenon Lamps; Mathematical Models; Electrical Networks; Computer Programs; FORTRAN  
Secondary Keywords: Network Analysis Theory; FORTRAN 4 Programming Language; CDC 6400 Computers; Pulse Forming Networks; NTISDDDA

10429

ANALYSIS OF THE OPERATING REGIMES OF AN IMPULSE UNIPOLAR GENERATOR WITH REGULATION OF EXCITATION FLUX

V.V. Kharitonov

Army Foreign Sci. and Tech. Center, Charlottesville, VA  
No. FSTC-HT-23-1883-73, 16p (04/1974).  
Availability: AD-781 225/8

A method of calculating transient processes in the field circuit of an impulse unipolar generator with massive magnetic conductor is examined. Based on the method, several generator operating regimes with regulation of excitation flux are analyzed.

Primary Keywords: Pulse Generators; Transients; Excitation; Computations; Translations; USSR  
Secondary Keywords: NTISDDDA

**10430 DEVELOPMENT OF AN ELECTRICAL DISCHARGE IN GAPS WITH GREAT OVERVOLTAGE AT LOW AIR PRESSURE**

Y.I. Bychkov, V.V. Osipov, Y.A. Kurbatov and A.G. Filonov  
Army Foreign Sci and Tech Center, Charlottesville, VA  
No. FSTC-MT-23-1841-73, 8p (08/1973).  
Availability: AD-781 137/3

NTIS

The physical processes responsible for breakdown of gas gaps with overvoltages of a few percent have been studied in a number of works both oscillographically and optically. Theoretical calculations have shown that known experimental facts are explained well by the theory of Townsend avalanche generation. In the present work, the authors studied the development of a discharge in gaps of 1-6 cm with overvoltages of 2-20 times, and also measured the time characteristics, both the discharge delay time (t sub d), the time of switching to the 0.5 (U sub 0) level and the duration of the 'step' as functions of the electric field voltage.

Primary Keywords: Electric Discharges; Glow Discharges; Gas Discharges; Pulse Generators; Low Pressure; Translations; USSR

Secondary Keywords: NTISDDDA

**10431 EBS (ELECTRON BEAM SEMICONDUCTOR) PULSE AMPLIFIER LIFE TEST**

Authors Unknown  
Watkins-Johnson Co., Palo Alto, CA  
Final engineering rpt, 13 Feb 73-28 Jan 74. (01/1974).  
Availability: AD-779 908/3

NTIS

Highly stable, high voltage, beam shield passivated diodes were fabricated for use in EBS (electron beam semiconductor) grid controlled pulse amplifiers. Six EBS pulse amplifiers were fabricated using these diodes and four of the EBS amplifiers were operated on life test for a total socket time of 14,500 hours. Data is presented showing that stable diode operation was obtained. (Author)

Primary Keywords: Pulse Amplifiers; Electron Beams; Semiconductor Diodes; Electron Tube Targets; Electron Tubes; Life Tests

Secondary Keywords: NTISN

**10432 A DEVICE FOR FORMING PULSES WITH A STEEP FRONT**

I.G. Kataev  
Naval Research Lab, Washington, DC 20375  
No. NRL-Trans-1293, 3p (05/1974).  
Availability: AD-779 897/8

NTIS

The patent describes a device for forming pulses with a steep front, which includes an artificial delay line with lumped parameters and which differs in that, for the purpose of increasing the steepness of the pulse front, the elements of the line are capacitors with a ferroelectric and inductance made of ferrites connected by one of the familiar circuits for a delay line.

Primary Keywords: Electrical Networks; Pulse Generators; Pulses; Patents; Delay Lines; Translations; USSR

Secondary Keywords: NTISN

**10433 EXPLOSIVE ELECTRON EMISSION AND THE CHARACTERISTICS OF HIGH-CURRENT ELECTRON FLOW**

R.K. Parker  
AFML, Kirtland AFB, NM 87117  
Final rept, Oct 70-Jan 73 No. AFML-TR-73-92, 298p (02/1974).  
Availability: AD-775 992/1

NTIS

Within the past several years, an increasing effort has been concentrated on the development of high-current, relativistic electron beams. Initially, this effort had been impeded by limitations in the high-voltage and pulsed-power technology required to develop pulsed, high-power electron accelerators. These technologies have been developed to a level where powers on the order of 10 to the 13th power watts are now available for time durations of approximately 100 nanoseconds. Emphasis has more recently been centered on controlling and concentrating these beams. The initial behavior of the beam within the diode region of the accelerator becomes an extremely critical element. The high-current, cold-cathode diode which is distinguished by non-self-convergent electron flow has been studied to define operative electron emission mechanisms, to determine the dominant plasma phenomena within the interelectrode volume, to classify the modes of electron flow, and to verify the Friedlander beam convergence criterion. (Modified author abstract)

Primary Keywords: Electron Beams; Electron Accelerators; Electron Emission; Pulse Generators; Plasmas(Physics); Diodes; X Rays; Relativity Theory; Wave Equations

Secondary Keywords: AF

**10434 HERTZIAN GENERATOR DEVELOPMENT**

S.D. Houston and D. Bailey  
BOM Corp, Albuquerque, NM 87106  
Technical rept. (Final) No. BOM/A-90, 74p (12/1973).  
Availability: AD-774 567/2

NTIS

The report summarizes the results of a one-year theoretical and experimental study of the frozen wave Hertzian concept for electromagnetic wave generation. The bulk of the effort was devoted to the switch problem, in particular, switch synchronization. Several configurations are evaluated and the design of a 200 MHz generator is treated in some detail. Limitations on frequency, efficiency, power, etc., are discussed in terms of available switch technology, materials, etc. (Author)

Primary Keywords: Radiofrequency Generators; Ultrahigh Frequency; Very High Frequency; Pulse Generators; Generators; Microwaves

Secondary Keywords: AF

**10435 ELECTRON BEAM SEMICONDUCTOR DEVICES**

M. Braun and K. Garuwal  
Machlett Labs Inc, Stamford, CT  
Final rept, 1 Mar 72-21 Feb 73 (07/1973).  
Availability: AD-766 740/5

NTIS

During the course of the contract, five EBS amplifiers, designated as EE-155, and 15 mounted EBS diodes, designated as EE-154 A and B, were developed, fabricated and delivered to the USAECOM. Diode area was 10 sq. cm and 20 sq. mm, active width of N region 25 micrometers, with resistivity of 20 ohm-cm. The electron beam of the amplifiers is generated and modulated by a cathode grid structure, with a focus electrode for beam diameter control. Best back bias voltage of the 20 diodes delivered exceeds 400 volts, with an average of 300 volts. First tests at USAECOM were done on a 70 sq. mm diode tube at 235V back bias voltage. Peak current into 3.8 ohm load was 46A, a peak power of 8 kW with a pulse risetime of 1.5 ns. Risetime, when corrected for the input pulse, is approximately 1 ns. (Author)

Primary Keywords: Microwave Amplifiers; Pulse Amplifiers; Diodes(Semiconductor); Radiofrequency Amplifiers; Electron Tube Targets; Reliability(Electronic); Manufacturing Methods; Electron Beams

Secondary Keywords: Electron Beam Semiconductor Devices; A

**10436 SOLID STATE PULSER USING PARALLEL STORAGE CAPACITORS**

D.J. Amberger and R.A. Culiceno  
Department of the Army, Washington, DC  
Patent No. PAT-APPL-72 954, 4p (07/1972).  
Availability: AD-163 796/6

The patent describes a solid state pulse generator that produces high current narrow pulses and includes a bank of parallel silicon controlled rectifier-capacitor combinations, designed for driving a gallium arsenide diode laser. A trigger circuit is connected to all the gate circuits of the silicon controlled rectifiers, through separate adjustable resistors. The adjustable resistors make it possible to simultaneously fire the silicon controlled rectifiers with a single trigger pulse.

Primary Keywords: Lasers; Pulse Generators; Pulse Generators; Patents; Photo Diodes; Gallium Arsenide; Lasers

Secondary Keywords: Semiconductor Lasers; Light Emitting Diodes; Injection Lasers; GPA

Distribution Restriction: GOVERNMENT-OWNED INVENTION AVAILABLE FOR LICENSING. COPY OF PATENT AVAILABLE COMMISSIONER OF PATENTS, WASHINGTON, D.C. 20231 60.50.

**10437 CIRCUIT PROTECTING GAS-TUBE DISCHARGE INTERRUPTER**

S. Schneider and G.M. Taylor  
Department of the Army, Washington, DC  
Patent No. PAT-APPL-791 460, 4p (11/1970).  
Availability: AD-163 603/4

NTIS

The patent relates to energy control and particularly to energy control in the form of isolation and protection for multiple amplifier circuits operating from a common power source. More particularly, this disclosure is of the use of gas tubes as switches for isolating and protecting individual pulse-amplifier circuits or units of a multiple-unit system having a common power supply. This disclosure teaches the connection of a gas tube controlled by a magnetic field to each of the circuits to switch it off when the circuit faults or short circuits and to switch the circuit back on when the fault clears itself. This avoids draining the main capacitor bank through the short-circuit, which could damage the individual circuit and interfere with the operation of other circuits using the same common power supply.

Primary Keywords: Switching Circuits; Discharge Tubes; Patents; Switching Circuits; Power Supplies; Control Systems; Pulse Amplifiers; Electric Switches

Secondary Keywords: PAT-CL-317-51; GPA  
Distribution Restriction: AVAILABILITY: GOVERNMENT-OWNED INVENTION AVAILABLE FOR LICENSING. COPY OF PATENT AVAILABLE COMMISSIONER OF PATENTS, WASHINGTON, D.C. 20231 60.50.

**10438 GAS TUBE ISOLATOR AND CHARGING CIRCUIT FOR PULSE AMPLIFIERS IN PHASED ARRAYS**

S. Schneider  
Department of the Army, Washington, DC  
Patent No. PAT-APPL-95 174, 5p (12/1971).  
Availability: AD-163 579/6

NTIS

The patent relates to energy control and particularly to energy control for charging energy storage devices and for isolating and protecting multiple amplifier circuits operating from a common power supply. More particularly, disclosure relates to the use of a gaseous tube as a switch for charging the energy storage capacitor bank of an individual pulse amplifier circuit or unit of a multiple unit system having a common power supply.

Primary Keywords: Switching Circuits; Discharge Tubes; Patents; Switching Circuits; Pulse Amplifiers; Phased Arrays; Power Supplies; Control Systems

Secondary Keywords: PAT-CL-317-51; GPA  
Distribution Restriction: AVAILABILITY: GOVERNMENT-OWNED INVENTION AVAILABLE FOR LICENSING. COPY OF PATENT AVAILABLE COMMISSIONER OF PATENTS, WASHINGTON, D.C. 20231 60.50.

**10439 DISCHARGING OF INDUCTIVE POWER ACCUMULATOR FOR GENERATING SHORT-FRONT PULSE**

V.N. Bolshakov  
Joint Publications Research Service, Arlington, VA  
(05/1973).  
Availability: JPRS-58892

NTIS

The report contains a discussion of the basic parameters of the discharge circuit of an inductive accumulator for generating a current pulse with a short front.

Primary Keywords: Pulse Generators; Electric Coils; Discharge; Power Supply; Circuits; USSR; Translations

Secondary Keywords: JPRS

10448  
ELECTRON BEAM SEMICONDUCTOR SHORT PULSE GENERATOR  
A. Silzer and R.I. Knight  
McKinnon-Johnson Co., Palo Alto, CA  
Final rept. 1 Aug 70-1 Oct 72 No. W-J-22-4083-F, 91p (05/1973).  
Availability: AD-761 111  
NTIS

Detailed analysis, design, and experimental verification of an electron beam semiconductor (EBS) amplifier for a high-speed high-current switching application has been completed. A large-signal computer simulation predicts that with an ideal diode structure over 450 amperes of output current can be achieved into an 0.5 ohm load with a risetime of less than 0.7 nanosecond. A gridded gun design was used as the most suitable approach. The cathode-grid structure showed over 80 percent of the design goal performance with uniform current density at the target position. Large area semiconductor targets of 0.35 sq. cm. and 1.48 sq. cm. active area have been successfully fabricated from 37 micrometers thick, 22 ohm/cm epitaxial silicon. The best diodes have leakage currents of less than 10 mA at 250 volts reverse breakdown voltage. Tube processing and pulsed operation did not change the diode characteristics. (Modified author abstract)

Primary Keywords: Pulse Amplifiers; Design; Electron Tube Targets; Diodes (Semiconductor); Electron Guns; Silicon; Reliability (Electronics); Manufacturing Methods

Secondary Keywords: Computer Aided Design; A

10441  
HIGH EFFICIENCY CURRENT DRIVER  
L. Simpson  
Department of the Army, Washington, DC  
Patent No. PAT-APPL-717 196, 4p (12/1970)  
Availability: AD-763 514/8  
NTIS

The driver is concerned with providing high current pulses of positive and/or negative polarity as desired. The device is charged by a D.C. voltage through a high impedance resonant network and discharges through a low impedance resonant network that includes a SCR that is turned on as desired by small current gating signals. A large current pulse, on the order of 25 amps during discharge, is inductively coupled to an output winding.

Primary Keywords: Pulse Generators; Patents; Electric Currents

Secondary Keywords: PAT-CL 320-1; CPA

Distribution Restriction: AVAILABILITY: GOVERNMENT-OWNED INVENTION AVAILABLE FOR LICENSING. COPY OF PATENT AVAILABLE COMMISSIONER OF PATENTS, WASHINGTON, D.C. 20231 00.50.

10442  
EXPERIMENTAL AND ANALYTICAL RESEARCH ON A TWO MEGAWATT, HIGH PERFORMANCE MHD GENERATOR  
D.K. Sonju and J. Teno  
Avco Everett Research Lab., Inc., Everett, MA 02149  
Interim rept. 1 Apr 71-1 Oct 72 (10/1972).  
Availability: AD-756 489  
NTIS

The report presents the initial results of a combined analytical and experimental program whose broad objectives are to achieve a more complete understanding of the operation and appropriate design techniques of compact high-performance MHD generators by further establishing the detailed analytical basis of the performance of these generators and to demonstrate the feasibility of operating compact high-performance MHD generators under a repetitively pulsed mode of operation at high power levels--in this case at the 2 MW level. In particular, the results of studies of stability, and effects of transient response, diagnostic, rapid startup, channel voltage breakdown and performance optimization are discussed and summarized. A parallel effort under this program has been directed to constructing a generator test facility and designing and fabricating a 2 MW high-performance MHD generator system to be used in the test facility. (Author)

Primary Keywords: Magnetohydrodynamic Generators; Scientific Research; Magnetohydrodynamics; Combustion Chambers; Nozzles; Heat Transfer; Cooling; Magnets; Motors; Pulse Generators; Electrodes; Mass Transfer; Circuits; Graphs; Efficiency; Transients

Secondary Keywords: Viking 1 Program

10443  
A 750 KW PULSE GENERATOR AND ITS USE FOR THE PRODUCTION OF X-RAY AND ELECTRON FLASHES  
F. Mattarom, F. Jamet and G. Thomer  
Institut Franco-Allemand Recherches, St. Louis, France  
No. ISL-10/72, 37p (05/1972).  
Availability: WJ3-12472  
NTIS

A Marx generator producing in vacuum impulses from 200 to 750 kV is described. Its elements are immersed in a liquid and coaxially mounted in a nitrogen pressurized chamber. The self-induction of the set-up is 1.5 micro H when used with a flash tube, the X-ray impulses are characterized by their high intensity and a 25 nsec pulse duration. This generator is suitable for electron pulse production and therefore for photographic or semiconductor pumping when used in conjunction with beryllium window tubes. (Author)

Primary Keywords: Electrons; Pulse Generators; X Rays; Electron Photography; Experimental Design; Flash Lamps; Optical Pumping; Pulse Duration; Radiography

10444  
DISCHARGE IN GAS AT HIGH PRESSURE INITIATED BY A BEAM OF FAST ELECTRONS  
B.M. Kovalchuk  
Defence Research Information Centre, Orpington (England).  
No. DRIC-TRANS-2857, 16p (08/1971).  
Availability: WJ3-11716  
NTIS

Discharge in nitrogen at pressures up to 16 atm. initiated by a beam of electrons with an average energy of 100 to 350 keV was investigated. A channel-free form of discharge was obtained with voltages above 100,000 V and switching currents of some tens of kA. The channel-free form of discharge is characterized by absorption in the gas of specific power of the order of 10 to 1000 MW/cm or more in a time interval of the order of 100 microseconds. (Author)

Primary Keywords: Electron Beams; Gas Discharges; High Pressure; Nitrogen; Electric Pulses; Electron Avalanches; Pulse Amplitude; Pulse Generators; Spark Gaps

10445  
METHOD OF GENERATING UNIPOLAR AND BIPOLAR PULSES  
N.E. Dixon  
Atomic Energy Commission, Washington, DC  
Patent No. PAT-APPL-111 951, 10p (04/1972).  
Availability: PATENT-3 656 012  
NTIS

The method for generating bipolar and unipolar mechanical pulses is described. The unipolar pulses can be in a form of a single unipolar pulse or pairs of unipolar pulses of opposite polarity. (Author)

Primary Keywords: Transducers; Patents; Ultrasonic Tests; Transducers; Pulse Generators; Nondestructive Tests

Secondary Keywords: Pat-cl 310-8-1

Distribution Restriction: GOVERNMENT-OWNED INVENTION AVAILABLE FOR LICENSING. COPY OF PATENT AVAILABLE COMMISSIONER OF PATENTS, WASHINGTON, D.C. 20231 00.50.

10446  
EXPLOSIVE-DRIVEN EMP GENERATOR  
K.M. Soo Moo  
Aerospace Corp., El Segundo, CA 90245  
Rept. for Jul 71-Jun 72 No. IR-0073(3542-02)-1, 33p (11/1972).  
Availability: AD-751 907  
NTIS

The feasibility of radiating large quantities of energy from a satellite is discussed. A system comprised of an explosive generator source, switching and matching networks, and a bent-dipole antenna is theoretically analyzed. The calculations indicate that an electric field of 400 V/m can be produced at a distance of 1 mile from the source. (Author)

Primary Keywords: Pulse Generators; Electromagnetic Pulses; Explosions; Dipole Antennas; Satellites (Artificial)

Secondary Keywords: Explosive Generators

10447  
THE POSSIBILITY OF USING LIQUID DISCHARGES IN HIGH-VOLTAGE NANOSECOND PULSE CIRCUITS  
D.A. Masys and G.A. Vorobev  
FTD, Wright-Patterson AFB, OH  
No. FTD-MT-23-939-72, 10p (09/1972).  
Availability: AD-751 170  
NTIS

The article compares the commutation time  $t_{sub k}$  of air and oil discharges and shows that in the latter  $t_{sub k}$  is less. It is also found that the durability of the c l during short pulses does not depend on its humidity. (Author)

Primary Keywords: Electric Discharges; Dielectrics; Oils; Air; USSR

Secondary Keywords: Insulating Oil; Transitions; Dielectric Breakdown

10448  
MULTIMEGAJoule PULSED POWER GENERATION FROM A REUSABLE COMPRESSED MAGNETIC FIELD DEVICE  
M. Cowan, E.C. Chare, W.K. Tucker and D.R. Mesenberg  
Sandia Labs, Albuquerque, NM 87115  
No. CONF-741163-2, 4p (09/1972).  
Availability: SAND-75-5574  
NTIS

For abstract, see NSA 32 08, number 19584.

Primary Keywords: Pulse Generators; Design; Combustion; Performance; Superconducting Magnets; Switching Circuits

Secondary Keywords: NTISERDA

10449  
THREE-GAP SPARK DISCHARGER FOR SPARK CHAMBER SUPPLY  
G.D. Alekseev and D.M. Khazin  
Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.  
(01/1974).  
Availability: JINR-P13-8390  
NTIS

For abstract, see NSA 32 01, number 00919.

Primary Keywords: Spark Chambers; High-voltage Pulse Generators; High-voltage Pulse Generators; Design; Performance; Pulse Rise Time; Timing Properties

Secondary Keywords: NTISERDA

Distribution Restriction: IN RUSSIAN. U.S. SALES ONLY.

10450  
UNTRIGGERED MULTICHANNEL OIL SWITCHING  
D.L. Johnson  
Sandia Labs, Albuquerque, NM 87115  
No. CONF-741113-2, 16p (01/1974).  
Availability: SAND-74-5590  
NTIS

For abstract, see NSA 31 06, number 14735.

Primary Keywords: Electrostatic Accelerators; High-voltage Pulse Generators; High-voltage Pulse Generators; Switching Circuits; Operation; Performance; Pulse Rise Time; Switches

Secondary Keywords: NTISAEAC

10451  
2 MV, MULTICHANNEL, OIL-DIELECTRIC, TRIGGERED SPARK GAP  
K.R. Prestwich  
Sandia Labs, Albuquerque, NM 87115  
No. CONF-741113-3, 22p (01/1974).  
Availability: SAND-74-5270  
NTIS

For abstract, see NSA 31 06, number 14734.

Primary Keywords: Electrostatic Accelerators; High-voltage Pulse Generators; High-voltage Pulse Generators; Switching Circuits; Spark Gaps; Switches; Trigger Circuits

Secondary Keywords: NTISAEAC

10452  
HIGH-VOLTAGE POWER SUPPLY FOR A HIGH-CURRENT INJECTOR  
I.T. Venavtsev, G.M. Skoromnyi, Z.E. Ptukhina, E.I. Revutskii and V.V. Verbovskii  
AN Ukrainskoj SSR, Kharkov Fiziko-Tekhnicheskij Inst.  
Availability: BNL-tr-579  
NTIS

For abstract, see NSA 31 02, number 04064.

Primary Keywords: High-voltage Pulse Generators; Specifications; Accelerators; High-voltage Pulse Generators; Beam Injection; Electronic Circuits; Power Supplies

Secondary Keywords: NTISAEAC

Distribution Restriction: TRANSLATED BY S.J. AMORETTY FROM PP 66-68 OF KHFTI--73-13.

10453  
**PULSED CASCADE TRANSFORMER**  
 I.V. Venavtsov, G.M. Skoromnyy and E.I. Revutskii  
 AN Ukrainskoj SSR, Khar'kov Fiziko-Tekhnicheskij Inst.  
 Availability: BNL-tr-577  
 NTIS  
 For abstract, see NSA 31 02, number 04863.  
 Primary Keywords: Linear Accelerators; High-voltage Pulse Generators;  
 Beam Injection; Particle Beaters; Power Supplies;  
 Transformers  
 Secondary Keywords: NTISAE  
 Distribution Restriction: TRANSLATED BY S.J. AMORETTY FROM PP 69-71 OF  
 KNPFI--73-13.

10454  
**SOME PECULIARITIES OF OPERATION OF CURRENT COMMUTATOR ON INDUCTIVE LOAD**  
 I.S. Borobash, S.M. Bilakii and V.A. Timokhin  
 Joint Inst. for Nuclear Research, Dubna (USSR).  
 (01/1974).  
 Availability: JINR-P9-7773  
 NTIS  
 For abstract, see NSA 30 03, number 07489.  
 Primary Keywords: Accelerators; Pulsed Magnet Coils; Pulsed Magnet  
 Coils; Pulse Circuits; Electronic Circuits; Power  
 Supplies; Pulse Generators; Semiconductor Diodes;  
 Thyristors  
 Secondary Keywords: NTISAE  
 Distribution Restriction: IN RUSSIAN. U.S. SALES ONLY.

10455  
**INVESTIGATION OF THE RE-ESTABLISHMENT OF IMPULSE ELECTRICAL STRENGTH  
 AFTER DISCHARGE IN SPARK CHAMBERS WITH SMALL CLEARANCE**  
 V.I. Martynov and V.V. Rylov  
 Gosudarstvennyj Komitet Po Issue Zovaniyu Atomnoj Ehnergii Ssr,  
 Moscow. Inst. Teoreticheskij i Eksperimental'noj Fiziki.  
 (01/1973).  
 Availability: ITEP-25  
 NTIS  
 For abstract, see NSA 29 07, number 15744.  
 Primary Keywords: Spark Chambers; Operation; Electric Discharges;  
 Electric Potential; High-voltage Pulse Generators;  
 Timing Properties  
 Secondary Keywords: AEC  
 Distribution Restriction: IN RUSSIAN. U.S. SALES ONLY.

10456  
**SMALL PULSE BREAKDOWN PHENOMENON IN MINERAL INSULATED CABLES**  
 K.M. McMin  
 Ukase Reactor Group, Winfrith, Atom. Energy Establishment.  
 (11/1973).  
 Availability: AEEN-R-910  
 NTIS  
 For abstract, see NSA 29 07, number 15673.  
 Primary Keywords: Neutron Detectors; Electric Cables; Electric  
 Cables Breakdown; Dielectric Materials; Gases;  
 Minerals; Pulse Circuits  
 Secondary Keywords: AEC  
 Distribution Restriction: U.S. SALES ONLY.

10457  
**ELECTRON-BEAM-CONTROLLED GAS LASERS: DISCUSSION FROM THE ENGINEERING  
 VIEWPOINT: PART II. PROBLEMS IN THE ELECTRICAL DESIGN OF VERY HIGH  
 ENERGY SYSTEMS**  
 R. B. Rice and R.E. Stapleton  
 Los Alamos National Labs, Los Alamos, NM 87545  
 No. CONF-731114-40, 17p (01/1973).  
 Availability: LA-UR-73-1630  
 NTIS  
 For abstract, see NSA 29 06, number 15151.  
 Primary Keywords: Lasers; Electron Beams; Efficiency; Energy Transfer;  
 Excitation; Pulse Generators; Specifications  
 Secondary Keywords: AEC

10458  
**SUSCEPTIBILITY OF PULSE NUCLEAR MEASURING EQUIPMENT TO ELECTRICAL  
 INTERFERENCES**  
 J. Buisson  
 CEA Centre d'Etudes Nucleaires, Sarclay, France 92260  
 (02/1973).  
 Availability: CEA-R-4425  
 NTIS  
 For abstract, see NSA 28 01, number 00568.  
 Primary Keywords: Pulse Circuits; Interference; Measuring  
 Instruments; Interference; Electric Currents;  
 Variations  
 Secondary Keywords: AEC  
 Distribution Restriction: IN FRENCH. U.S. SALES ONLY.

10459  
**SNCP DRAWINGS FOR A MEDIUM SIZE MARX GENERATOR: TECHNICAL REPORT NO.  
 73-009**  
 M.S. Risk  
 University of Maryland, College Park, MD 20742  
 (08/1972).  
 Availability: ORD-2504-184  
 NTIS  
 For abstract, see NSA 27 06, number 14416.  
 Primary Keywords: Pulse Generators ELECTRONICS  
 Secondary Keywords: AEC

10460  
**HIGH-VOLTAGE PULSE GENERATORS FOR STREAMER CHAMBERS**  
 M.M. Kuliyukin, D.B. Pontokorvo, V.M. Sereko, I.V. Faleokin and Y.A.  
 Shcherbakov  
 Joint Inst. for Nuclear Research, Dubna (USSR). Lab. Of Nuclear  
 Problems.  
 (01/1972).  
 Availability: JINR-P13-6553  
 NTIS  
 For abstract, see NSA 26 21, number 50698.  
 Primary Keywords: Pulse Generators ELECTRONICS; Radiation Detectors/  
 Spark Chamber

10461  
**GENERATOR OF EXTENDED DURATION HIGH VOLTAGE PULSES**  
 J. Gaucher and G. Roux  
 CEA Centre d'Etudes Nucleaires, Sarclay, France 92260  
 (02/1972).  
 Availability: CEA-M-1516  
 NTIS  
 For abstract, see NSA 26 17, number 46984.  
 Primary Keywords: Pulse Generators ELECTRONICS

10462  
**ELECTRON BOMBARDED SEMICONDUCTOR SHORT PULSE GENERATOR**  
 A. Silzer  
 Watkins-Johnson Co., Palo Alto, CA  
 Triannual rept. no. 5, 1 Dec /1-31 Mar 72 (09/1972).  
 Availability: AD-748 898  
 NTIS

Improved fabrication processes for large area semiconductor  
 targets and complete high current amplifiers were developed. Large  
 area (1.40 sq. cm active area) semiconductor diodes, with leakage  
 current of less than 10 mA at reverse bias voltages of 250 volts were  
 fabricated. Initial tests were made on a completely processed tube  
 with an internal getter instead of a two liter space charge pump. Three  
 complete high current pulse amplifiers were fabricated and tested for  
 diode saturation characteristics and pulse performance. The  
 performance was determined for both grid-driven and cathode-driven  
 operation. (Author)  
 Primary Keywords: Pulse Amplifiers; Design; Pulse  
 Generators; Performance; Engineering; Electron Tube  
 Targets; Semiconductors; Electron Guns;  
 Diodes (Semiconductor); Silicon; Manufacturing Methods

10463  
**MULTITUDE GENERATOR BANK**  
 G.I. Zverev, V.L. Lyulov, V.B. Maiburov, I.S. Savchenko and I.R.  
 Yemelilov  
 Joint Publications Research Service, Arlington, VA  
 (05/1972).  
 Availability: JPRS-56371  
 NTIS

Four-phase tube generators for excitation of the circuits shaping  
 the high-frequency fields of various configurations used in plasma  
 physics research are described. The generators can operate in two  
 modes: independent excitation and autoexcitation. In the  
 autoexcitation mode the load is the field-shaping circuit. The  
 total installed power of the generator bank tubes is about 80  
 megawatts per pulse lasting 1-1.5 milliseconds with a duty cycle  
 frequency of 0.5 to 2 megahertz and a pulse repetition rate of 0.05  
 to 0.1 hertz. The problem of obtaining high power is solved by  
 adding the powers of groups of generator tubes included in parallel  
 in the load. (Author)  
 Primary Keywords: Pulse Generators; Design; Plasmas (Physics); Pulse  
 Generators; Tube Components; Voltage Regulators;  
 Translations; USSR

10464  
**(DIAGNOSTICS AND INSTRUMENTATION)  
 (Power)  
 KDS AND BKD CALORIMETRIC ENERGY METERS FOR HIGH-POWER LASER PULSES**  
 Soviet Journal Of Quantum Electronics, Vol. 8, No. 3, pp 419-420  
 (03/1978).  
 Trans. From: Kvantovaya Elektronika (Moscow), Vol. 5, pp 789 (March  
 1979)

Primary Keywords: Thermal Radiation Detectors; Thermoelectric Battery;  
 High Damage Threshold; Specifications Given  
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10465  
**(PARTICLE BEAMS, ELECTRON)  
 (Generation)  
 MILLISECOND MEGAJOULE ACCELERATOR FOR BEAM INDUCED THERMONUCLEAR  
 MICROEXPLOSIONS**

F. Winterburg  
 Univ Of Nevada, Reno, Nevada  
 Nuclear Instruments And Methods 136 (1976), pp 437-440 (12/1976).  
 A novel concept for an intense relativistic beam accelerator is  
 proposed which can deliver megajoule energies on the time scale of  
 one nanosecond with a total beam power of 10<sup>15</sup> W thereby reaching  
 conditions as they are required for the ignition of thermonuclear  
 microexplosions. 11 Refs.  
 Primary Keywords: One Ms Pulse; 10<sup>15</sup> W Beam Power; Ignition Of  
 Thermonuclear Microexplosions; Transmission Line  
 Type Accelerator  
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10467  
**(INSULATION, MAGNETIC)  
 ( )  
 ONE- AND TWO-SPECIES EQUILIBRIA FOR MAGNETIC INSULATION IN COAXIAL  
 GEOMETRY**

X.D. Bergeron  
 Sandia Labs, Albuquerque, NM 87115  
 The Physics Of Fluids, Vol. 20, No. 4, pp 688-697 (04/1977).  
 A cold-fluid, self-consistent model of electron and ion flow in  
 coaxial cylindrical geometries is applied to the problem of  
 magnetically insulated diodes. The one species, nonrelativistic  
 problem is studied to determine in what configurations and parameter  
 domains equilibria corresponding to magnetic insulation exist. It is  
 proved that when the outer electrode is the cathode, equilibria  
 always exist. For an inner cathode, whether or not equilibria exist  
 and whether they are unique depends on whether the field is azimuthal  
 or longitudinal and on the ratio of the radii. The two-species  
 relativistic problem is then analyzed with the help of a  
 computational routine which integrates the cold-fluid differential  
 equations and searches the parameter space for the point  
 corresponding to space charge limited emission. As the critical field  
 is approached from above, the resulting values of ion current show an  
 enhancement over the single species prediction by a factor which  
 increases with voltage and with anode radius. Patterns of  
 nonexistence of equilibria similar to those observed for the  
 one-species, nonrelativistic case are also found. 17 Refs.  
 Primary Keywords: Coaxial Magnetically Insulated Diodes; Cold-fluid,  
 Self-consistent Model; Electron And Ion Flow;  
 Determination Of When Equilibria Exist; Outer  
 Cathode; Inner Cathode; Space Charge Limited  
 Emission; Critical Field Enhancement  
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10468  
(PARTICLE BEAMS, ELECTRON)  
(Diagnostics)  
POTENTIAL OF A HOLLOW ELECTRON BEAM IN A MAGNETICALLY-INSULATED DIODE  
S. P. Bugaev, A. A. Kim and V. I. Koshalev  
Academy of Sciences of the USSR, Tomsk, USSR  
Soviet Physics Technical Physics, Vol. 24, No. 8, pp 1007-1008  
(08/1979).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki, Vol. 49, pp 1790-1792  
(August 1979)

9 Refs.  
Primary Keywords: Magnetically Insulated Diode; Microsecond Accelerator; Potential Of A Hollow Electron Beam; Capacitive Voltage Divider; Graphite Collector; Burke Circuit; Plasma Propagation Velocity

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10469  
(POWER TRANSMISSION)  
(Transmission Lines)  
PROPAGATION OF POWER PULSES IN MAGNETICALLY INSULATED VACUUM TRANSMISSION LINES  
M. S. Di Capua and D. G. Pellinen  
Physics International  
Journal Of Applied Physics, Vol. 50, No. 5, pp 3713-3720 (05/1979).

25 Refs.  
Primary Keywords: Magnetically Insulated Vacuum Lines; 1.8 Mv, 80 KA Pulse; 41.6 Ohm Line; 4ns Risetimes; Peak Power Density 2x10<sup>9</sup> W/cm<sup>2</sup> up 27; Line Wave Impedance; Line Effects On Pulse Shape; Optimal Termination; Reflected Waves

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10470  
(BREAKDOWN STUDIES)  
(Exploding Wires)  
RADIATION FROM A DENSE PLASMA GENERATED BY AN EXPLODED WIRE IN VACUUM  
E. K. Chakalin and V. S. Shumenov  
G. M. Krzhizhanovskii Power Engineering Institute, Moscow, USSR  
Soviet Physics Technical Physics, Vol. 14, No. 1, pp 46-48 (07/1969).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki, Vol. 39, No. 1, pp 71-74  
(August 1974)

4 Refs.  
Primary Keywords: Optical And Spectral Properties; Copper And Aluminum Wires; 30 kV, 41 uF Capacitor Bank

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10471  
(PARTICLE BEAMS, ELECTRON)  
(Generators)  
MICROSECOND HIGH-CURRENT MAGNETICALLY INSULATED DIODES  
A. A. Bugaev, A. A. Kim and V. I. Koshalev  
Academy of Sciences of the USSR, Tomsk, USSR  
Soviet Physics Technical Physics, Vol. 24, No. 8, pp 924-925 (08/1979).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki, Vol. 49, pp 1659-1661  
(August 1979)

5 Refs.  
Primary Keywords: High Voltage Diodes; Magnetic Insulation; Return Current; Reduced Efficiency; Explosive Electron Emission; Electron Space Charge

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10472  
(BREAKDOWN STUDIES)  
(Solid, Radiation)  
SGEMP RESPONSE INVESTIGATION WITH EXPLODING-WIRE PHOTONS, PART II  
R. Stettner (1), B. M. Goldstein (1), V. A. J. Van Lint (2) and D. A. Fromme (2)  
(1) Mission Research Corporation, Santa Barbara, CA 93101  
(2) Mission Research Corp., Jolita, CA  
IEEE Transactions On Nuclear Science, Vol. NS-25, No. 6, pp 1342-1348  
(12/1978)

7 Refs.  
Primary Keywords: SGEMP; Exploding Wire; Discrepancies From Part I Resolved; Peak Skin Currents; Monopole Experiment; Dissimilar Materials Experiment

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10473  
(PARTICLE BEAMS, ELECTRON)  
(Generation)  
STRUCTURE OF THE HIGH-CURRENT RELATIVISTIC ELECTRON BEAM FORMED BY A COAXIAL GUN WITH MAGNETIC INSULATION  
M. A. Goshkova, V. P. Litvin, V. M. Mozhayev, V. Sveshnikov and M. I. Fuks  
Academy of Sciences of the USSR, Gor'kiy, USSR  
Soviet Physics Technical Physics, Vol. 25, No. 1, pp 63-66 (01/1980).  
Trans. From: Zhurnal Tekhnicheskoi Fiziki, Vol. 50, pp 109-114  
(January 1980)

A numerical solution is reported for the problem of the formation of a high-current beam of relativistic electrons in a coaxial diode gun with magnetic insulation. The beam structure and other basic characteristics are analyzed in a comparison with experimental results and analytic solutions based on models. 15 Refs.

Primary Keywords: Magnetic Insulation; Coaxial Gun; Numerical Solution; Comparison Of Numerical Solution With Experimental Results

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10474  
(BREAKDOWN STUDIES)  
(Gas, Electrical)  
TECHNICAL PROBLEMS INVOLVED IN H/SUB 2/ STREAMER CHAMBERS  
F. Rohrbach (1), J. J. Bonnet (2) and M. Cathenoz (3)  
(1) Univ Of Washington, Seattle, Washington  
(2) C.N.R.S., Paris, France  
(3) CERN, Geneva, Switzerland  
Nuclear Instruments And Methods 111 (1973) pp 485-495 (01/1973).

15 Refs.  
Primary Keywords: H/sub 2/ Streamer Chambers; Blumlein Line; Brief Pulses; High Reproducible Field; Additional Impurities; Marx Generator Miniaturization

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10475  
(PULSE GENERATORS)  
(Linear Amplifiers)  
A LOW-COST SUB-NAOSECOND PULSE AMPLIFIER  
M. Moore, G. Newton and P. Pollard  
University of Sussex, Sussex, UK  
Nuclear Instruments And Methods, Vol. 115, pp 181-184 (01/1973).  
Fast amplifiers for short-duration nanosecond pulses are described. These provide a bandwidth which is near the limit obtainable with conventional construction techniques and discrete component. Each has a gain of approximately 3.3 and a rise time of 0.7 ns. An output of between 0.5 and 1 V into 50 ohms is achieved. 1 Refs.

Primary Keywords: Compact Layout; UHF Wiring Techniques; 50 Ohm Output Impedance; Inverted Output; PNP Or NPN Types; Decoupled Power Supplies

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10476  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Partial Discharges)  
A SIMPLE PULSE-HEIGHT ANALYZER FOR PARTIAL-DISCHARGE-RATE MEASUREMENTS  
B. Barlikas and J. M. E. Levi  
Research And Development Labs, Ottawa, Ontario, Canada  
IEEE Transactions On Instrumentation And Measurements, Vol. IM-18, No. 4, pp 341-345 (12/1969).

7 Refs.  
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10477  
(PULSE GENERATORS)  
(Miscellaneous)  
A TECHNIQUE FOR VERY-HIGH-SPEED PULSE GENERATION WITH VARIABLE REPETITION RATE  
J. A. Cookin (1) and R. J. F. Dow (2)

(1) University of Southampton, Southampton, UK  
(2) James Cook University, Townsville, Queensland, Australia  
Proceedings Of The IEEE, (June 1974), pp 852-853 (06/1974).  
A simple technique is proposed for the generation of high-speed variable repetition rate pulse trains by summing the output pulses from a series of variable delay step recovery diode circuits. The diode switching times determine the maximum repetition rate, which is several gigahertz. 1 Refs.

Primary Keywords: Step Recovery Diode Circuit; Multistage System; Delay Lines; Common Base Transistor As Summer

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10478  
(PULSE GENERATORS)  
(Capacitive)  
AN ELECTROMAGNETIC, PLANE STRESS-WAVE GENERATOR  
R. F. Snell (1), DC MacKallor Jr. (1) and R. Guernsey (2)  
(1) McDonnell Douglas Astronautic Company, Huntington Beach, CA  
(2) Knolls Atomic Power Labs, Schenectady, NY  
Experimental Mechanics, (November 1973), pp 472-479 (11/1973).  
This paper describes a unique device that has been developed for the transient loading of models along straight and curved boundaries and that operates by discharge of a high-energy, high-voltage capacitor bank. In its present configuration, this device can generate uniform pressures from 1500 psi (10 MPa) to pressures that approach 100,000 psi (6.9 MPa) and that rise from zero to maximum pressure in 2 us and decay to approximately zero in another 2 us. The transient stress-wave patterns in photoelastic models loaded with this device have been recorded by a dynamic polariscope. The dynamic polariscope presently in use is identical to a static polariscope except that the light source is of a short enough duration (1/2 us) to photographically stop the movement of the photoelastic-fringe patterns caused by the stress wave. With the stress-wave generator and the dynamic polariscope transient photoelastic patterns have been recorded in a number of models. These patterns indicate that the scatter from duplicate shots performed with this technique is on the order of 3 percent. This represents a considerable improvement over the 15 percent scatter normally experienced with sheet-explosive loading techniques. This improvement and the rapid turnaround between shots (approximately 5 min) are distinct advantages this system has over other methods of dynamic loading. 17 Refs.

Primary Keywords: 1500 psi To 100,000 psi; Pressure Pulse; 2 us Rise Time; And Decay Time; Low Scatter; Spark Gap Trigger

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10479  
(PULSE GENERATORS)  
(Line Type)  
AVALANCHE TRANSISTOR PULSER FOR FAST-GATED OPERATION OF MICROCHANNEL PLATE IMAGE-INTENSIFIERS  
A. Lundy, J. R. Parker, J. S. Lunsford and A. J. Martin  
Los Alamos National Labs, Los Alamos, NM 87545  
IEEE Transactions On Nuclear Science, Vol. NS-25, No. 1, pp 591-597  
(02/1978).

Transistors operated in the avalanche mode are employed to generate a 1000 volt 10 to 30 nsec wide pulse with < 4 nsec rise and fall times. This pulse is resistively attenuated to 270 volts and drives the image intensifier tube which is a load of 200 pf. To reduce stray inductance and capacitance, transistor chips were assembled on a thick-film hybrid substrate. Circuit parameters, operating conditions, and coupling to the microchannel plate image-intensifier (MCP12) tube are described. To provide dc operating voltages and control of transient voltages on the MCP12 tube a resistance-capacitance network has been developed which (a) places the MCP12 output phosphor at ground, (b) provides programmable gains in f-stop steps, and (c) minimizes voltage transients on the MCP12 tube. 12 Refs.

Primary Keywords: Avalanche Pulsers; 2N3700 Transistors (National Semiconductor Corporation); Low Jitter

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10480  
(PULSE GENERATORS)  
(Miscellaneous)  
EFFECT OF DISSOCIATION PULSE CIRCUIT INDUCTANCE ON THE CUCL LASER  
A. A. Vetter (1) and N. M. Nerheim (2)  
(1) California Institute of Technology, Pasadena, CA  
(2) Jet Propulsion Lab, Pasadena, CA  
IEEE Journal Of Quantum Electronics, Vol. QE-14, No. 2, pp 73-74  
(02/1978).

The performance of the double-pulsed CuCl laser is improved by a decrease in the inductance of the dissociation pulse circuit. Higher efficiency is obtained due to a larger ground state copper atom population and optimum dissociation energy. 4 Refs.

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19481  
(POWER TRANSMISSION)  
(Transmission Lines)  
EHV AC PARALLEL TRANSMISSION LINE CALCULATIONS WITH APPLICATION TO THE  
NEAR RESONANCE PROBLEM

A. Chaston  
Brigham Young University, Provo, UT  
IEEE Transactions On Power Apparatus And Systems, Vol. PAS-88, No. 5,  
pp 627-634 (05/1969).

The use of shunt reactors with EHV transmission lines has introduced new problems, one of which is the induction of high voltages on a de-energized circuit of two parallel lines. This paper presents the matrix equations used in developing a digital computer program which takes into account the effects of electromagnetic induction, electrostatic coupling, distributed lines, and transposition. The computer program may also be used to calculate the effects of shunt reactors, series capacitors, and loads. The equations can be adapted to a wide range of applications, although the examples for this paper have been limited to the near resonance problem of parallel transmission lines. 9 Refs.

Primary Keywords: Parallel Lines; Matrix Equations; Digital Computer; Electromagnetic Induction; Electrostatic Coupling; Distributed Lines; Transposition; Shunt Reactors; Series Capacitors; Loads  
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19482  
(PARTICLE BEAMS, ELECTRON)  
(Generation)

ELECTRICALLY DRIVEN 200-JOULE PULSED LASER  
M.G. Basov, V.A. Denilychev, A.A. Ionin, I.B. Kovsh and V.A. Sobolev  
Academy of Sciences of the USSR, Moscow, USSR  
Soviet Physics Technical Physics, Vol. 18, No. 11, pp 1488-1491  
(05/1974).

Trans. From: Zhurnal Tekhnicheskoi Fiziki, Vol. 43, pp 2357-2363.  
An electrically driven CO<sub>2</sub> laser with a working volume of 10 liters at gas pressures up to 3 atm is described: an electron gun with a multitube cathode is used to ionize the active medium. The energy deposited in the working gas, the output power, and the efficiency are investigated for various mixture compositions and pressures. Emission pulses of 200 J are obtained with a pressure of 760 torr and a 1.5:1.4 mixture of CO<sub>2</sub>:N<sub>2</sub>:He. 11 Refs.

Primary Keywords: CO<sub>2</sub> Laser; Output Power; Efficiency; 10 Liter Working Volume; Multitube Cathode; Marx Generator  
(12MF, 200kV)

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19483  
(BREAKDOWN STUDIES)  
(Gas, Electrical)

HIGH-CURRENT DISCHARGES IN NITROGEN WITH AN INDUCTIVE STORAGE BANK  
E.A. Azarov, A.A. Bogomolov, B.P. Luvchenko, F.C. Petrov and V.A. Yagnov  
All-Union Institute, Leningrad, USSR  
Soviet Physics Technical Physics, Vol. 24, No. 2, pp 255-256 (02/1979).

Trans. From: Zhurnal Tekhnicheskoi Fiziki, Vol. 45, pp 441-443.  
In this note we report an experimental study of a high-current, high-pressure discharge in nitrogen initiated by an exploding wire. The initial stage of discharge of this kind has been studied in Refs. 1-3. 7 Refs.

Primary Keywords: Inductive Storage Bank Supply; Electrodes; Exploding Wires; Pulsed Pressure; Temperature  
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19484  
(SWITCHES, CLOSING)  
(Gas Gaps, Optical)

INVESTIGATION OF THE INFLUENCE OF THE DISCHARGE MEDIUM ON THE CHARACTERISTICS OF LASER-RADIATION-TRIGGERED DISCHARGE GAPS  
L.M. Bykhovskaya

All-Union Institute, Moscow, USSR  
Soviet Journal Of Quantum Electronics, Vol. 9, No. 10, pp 1242-1245  
(10/1979).

Trans. From: Kvantovaya Elektronika (Moscow), Vol. 6, pp 2117-2121.  
The results are presented of investigations of new current discharge gaps, having operating voltages of 9-7 and 20-16 kV and filled with various gas mixtures (argon and nitrogen, pure nitrogen). The dependences are given of the delays in firing the gaps, as a function of the voltage on the electrodes and of the energy of the laser pulses used for triggering (1-1.06J). The minimum triggering energy of the type I discharge gaps was 2 J, when using a radiation pulse having a width of 10 ns. The rise time of the voltage pulse produced was 6.5 nsec. The discharge gaps were used to control electrooptic switches in laser systems. A study was made of the radiation produced during the breakdown of the discharge gaps. The radiation pulse had a flat top and a rise time of 4-11 nsec. 8 Refs.

Primary Keywords: Ceramic Gaps; Argon And Nitrogen Vs Pure Nitrogen  
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19485  
(INSULATION, MAGNETIC)  
(Magnetic)

MAGNETIC INSULATION OF AN INTENSE RELATIVISTIC ELECTRON BEAM  
J. Collier, T.J. Grzechowski and G. Rekefi

Massachusetts Institute of Technology, Cambridge, MA  
Journal Of Applied Physics, Vol. 45, No. 7, pp 3211-3212 (07/1974)

A magnetic field is used as an insulator, preventing electrons from crossing the gap of a pulsed field-emission diode subjected to voltages of 100-250 kV. The diode is comprised of two concentric cylinders with a variable gap separation ranging from 2 to 6 mm. A pulsed magnetic field up to 15 kG is applied along the diode axis. When the magnetic field exceeds a certain critical value, the electron current (which is typically 10-30 kA) is reduced by approximately two orders of magnitude. The desired magnetic insulation lasts over the full 50 nsec voltage pulse. 12 Refs.

Primary Keywords: Intense E-beam; 100-250kV; Magnetic Field Up To 15kG; 50ns Pulse Length; Pulsed Field Emission Diode  
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19486  
(BREAKDOWN STUDIES)  
(Solid, Electrical)

MECHANISM FOR A SECONDARY SURFACE BREAKDOWN IN A REVERSE BIAS HIGH-VOLTAGE SILICON P-N JUNCTION

B.M. Ateev, I.V. Grekhov, M.A. Magomedov and Sh.R. Mutalibov  
Academy of Sciences of the USSR, Makhachkala, USSR  
Soviet Physics Technical Physics, Vol. 24, No. 8, pp 992-993 (08/1979).

Trans. From: Zhurnal Tekhnicheskoi Fiziki, Vol. 45, pp 1768-1770  
4 Refs.

Primary Keywords: Photomultiplier; Electroluminescence Spectrum; 700-1500V; 100-5 to 100-4 sec Excitation Pulses; Air vs Vacuum

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19487  
(ELECTROMAGNETIC COMPATIBILITY)  
(Hardness)

MODAL CHARACTERIZATION OF SKYNET RESPONSE TO ELECTRICAL AND PHOTON STIMULATION

V.A.J. Van Lint and D.A. Fromme  
Mission Research Corporation, La Jolla, CA 92038  
IEEE Transactions On Nuclear Science, Vol. NS-26, No. 6, pp 4989-4999  
(12/1979)

0 Refs.  
Primary Keywords: Structure Currents; Calculated Response; Model Descriptions; Exploding Wire Radiator Photon Excitation; Internal Sensor Response  
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19488  
(BREAKDOWN STUDIES)  
(Vacuum, Electrical)

PLASMA BUILDUP AND BREAKDOWN DELAY IN A TRIGGERED VACUUM GAP  
A.J. Green (1) and C. Christopoulos (2)

(1) University of Durham, Durham, UK  
(2) University of Nottingham, Nottingham, UK  
IEEE Transactions On Plasma Science, Vol. PS-7, No. 2, pp 111-115  
(06/1979).

The phenomena leading to the surface flashover across solid insulators in vacuum and the subsequent spread of the trigger plasma thus formed to bridge the main gap in a triggered vacuum switch are investigated experimentally. The results show that the breakdown proceeds in two stages. In the first stage a plasma is formed by electrons releasing and ionizing absorbed gases. The electrons are field emitted at the insulator-electrode junction and the breakdown delay is primarily affected by the trigger voltage. In the second stage the trigger plasma expands into the main gap with a speed depending on the trigger current and trigger electrode geometry, in accordance with a simple model. 14 Refs.

Primary Keywords: Time Delay; Flashover Mechanism; Expansion Of The Trigger Plasma  
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19489  
(PULSE GENERATORS)  
(Miscellaneous)

SINGLE-CHIP PULSE GENERATOR PROVIDES 50 MHZ WITH ADJUSTABLE DUTY CYCLE  
W.A. Palm

Control Data Corporation, Minneapolis, MN 55435

Electronic Design, Vol. 26, pp 72 (12/1976).

9 Refs.

Primary Keywords: MC10114; 50 Ohm Output Impedance  
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19491  
(SWITCHES, CLOSING)  
(Liquid, Self)

SWITCHING CHARACTERISTICS OF A DISCHARGE IN WATER

V.M. Kulashov, S.L. Nedoseev, V.P. Smirnov and A.M. Spektor  
Soviet Physics Technical Physics, Vol. 19, No. 1, pp 150-151 (07/1974).

Trans. From: Zhurnal Tekhnicheskoi Fiziki, Vol. 44, pp 230-232.  
The switching characteristics of discharge gaps are studied in water as a function of the characteristic impedance of the shaping line  $R_{sh}/Z_{sub}$  or over the range 2.5-30 Ohms. A line with an electrical length of 50 nsec is charged to < 120 kV. Most of the experiments are carried out at fields up to 10E6 V/cm. The minimum rise time,  $t_{au}/sub$ , is 7 nsec, and the maximum rate of current increase,  $I/t_{au}/sub$ , is 10E22 A/sec, are detected with  $R_{sh} = 13$  Ohms. Up to 50% of the energy stored in the line is absorbed in the switch during a pulse. The operation remains qualitatively the same with a voltage of 400 kV on a line with  $R_{sh} = 15$  Ohms. 5 Refs.

Primary Keywords: High Power Shaping Lines; Breakdown > 10e6V/cm; 7ns Risetime  
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19492  
(PULSE GENERATORS)  
(Systems)

SYSTEM FOR CALIBRATION OF SPEAR TRANSPORT LINE TOROIDS

T.V. Huang, M. Smith and K. Crook  
Stanford University, Stanford, CA 94305  
IEEE Transactions Of Nuclear Science, Vol. NS-24, No. 3, pp 1748-1750  
(06/1978).

A one nanosecond pulse generator has been developed for calibration of the intensity monitors (toroids) in the SPEAR transport lines. The generator, located at the toroid, is simple, low cost and resistant to radiation. This paper describes the generator, and its connection to the standard SLAC toroid calibration system. 0 Refs.

Primary Keywords: Ins Local Generator At Each Toroid  
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19493  
(PULSE GENERATORS)  
(Miscellaneous)

WIDE-BAND PULSE AMPLIFIER

F. Meyer

Siemens Artigesellschaft, Munich, Germany  
IEEE Journal Of Solid State Circuits, Vol. SC-13, No. 3, pp 409-411  
(06/1978).

In order to build a gigabit/second pulse amplifier for medium power applications a new transistor-distributed amplifier configuration was developed and tested. A five-section amplifier employing 5 GHz f(T) bipolar transistors has a frequency response from dc to 3.6 GHz. Results achieved were a 10 db gain, 150 ps step response rise time, and an amplitude of 4 V peak to peak across a 50 Ohm load. 4 Refs.

Primary Keywords: Dc To 3.6 GHz Response; Bipolar Transistors; Five-section  
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19494  
(DIAGNOSTICS AND INSTRUMENTATION)  
(Miscellaneous)

A BACK-HATCHED DELAY-LINE CLIPPING TECHNIQUE FOR USE WITH FAST AMPLIFIERS

B. Griffiths and Z.C. Tan

University of Auckland, Auckland, New Zealand

Proceedings Of The IEEE, May 1975, pp 820 (05/1975)

A modified delay-line clipping amplifier technique which overcomes the drift and low-frequency noise problems of conventional dc-coupled pulse amplifiers is proposed. This technique results in an amplifier system with low output reflection coefficient and excellent overload recovery characteristics. 0 Refs.

Primary Keywords: Delay Line Clipping Amplifier Technique; Low Output Reflection Coefficient; Low Noise And Drift Characteristics  
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